

PART NO. 7921

CHILTON'S

TRUCK AND VAN

M A N U A L

1 9 9 3 -

1997

COVERS ALL DOMESTIC AND IMPORT MODELS FOR U.S. AND CANADA



NEW AND IMPROVED... see back for details

WITH NEW ESTIMATED LABOR TIMES • TECHNICAL SERVICE BULLETIN INDEX • SCHEDULED MAINTENANCE CHARTS

FORD MOTOR CO.

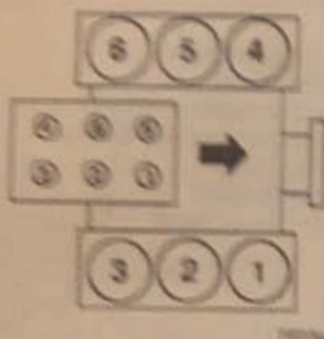
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Bronco • E-Series Van • Expedition • F-Series Pick-Up

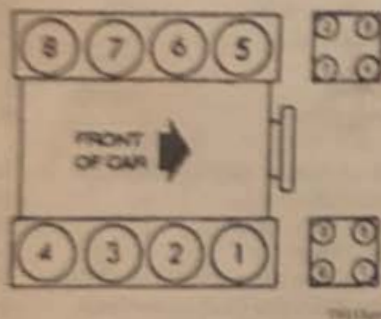
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FIRING ORDERS

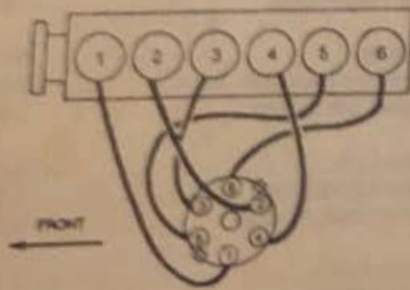
NOTE: To avoid confusion, always replace spark plug wires one at a time.



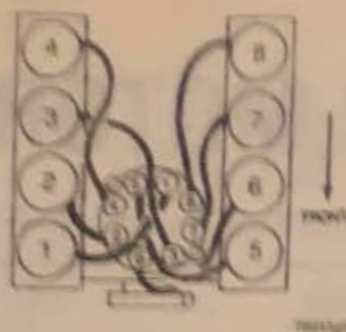
4.2L (VIN 2) Engine
Engine Firing Order: 1-4-2-5-3-6
Distributorless Ignition System (DIS)



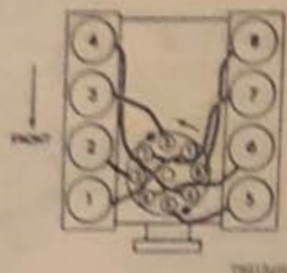
4.6L Engines (VIN W and VIN 6)
Engine Firing Order: 1-3-7-2-6-5-4-8
Distributorless Ignition System (DIS)



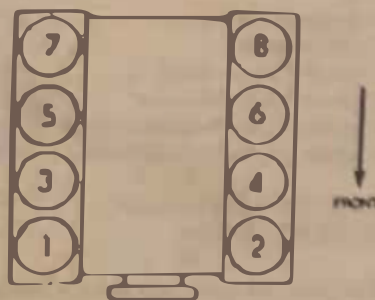
4.9L (VIN Y and Z) Engine
Engine Firing Order: 1-5-3-6-2-4
Distributor Rotation: Clockwise



5.0L (VIN N) and 7.5L (VIN G) Engines
Engine Firing Order: 1-5-4-2-6-3-7-8
Distributor Rotation: Counterclockwise



5.8L (VIN H and R) Engines
Engine Firing Order: 1-3-7-2-6-5-4-8
Distributor Rotation: Counterclockwise



7.3L (VIN C, F, K, and M) Diesel Engines
Engine Firing Order: 1-2-7-3-6-5-4-8

ENGINE ELECTRICAL

NOTE: Disconnecting the negative battery cable on some vehicles may interfere with the functions of the on board computer systems and may require the computer to undergo a relearning process, once the negative battery cable is reconnected.

Distributor

REMOVAL

1. Disconnect the primary wire connector from the distributor.
2. Mark the position of the cap No. 1 terminal on the distributor base.
3. Unclip and remove the cap. Move the adapter.
4. Remove the rotor.
5. Remove the TFI connector.
6. Matchmark the distributor base and engine for installation reference.
7. Remove the hold-down bolt and lift out the distributor.

INSTALLATION

Timing Not Disturbed

1. Visually inspect the distributor. The O-ring should fit tightly onto the housing and be free of cuts. The drive gear should be free of nicks, cracks, or excessive wear. The distributor shaft should rotate freely, without any binding.

2. Lubricate the distributor gear teeth with a coating of engine assembly lubricant, such as Ford D9AZ-19579-D, or with fresh motor oil meeting Ford specification ESR M99C80-A.

3. Align the locating boss and fully seat the distributor rotor on the distributor shaft, if removed.

4. Rotate the distributor shaft so that the distributor rotor blade points toward the marked position on the distributor base adapter.

5. Install the distributor assembly into the engine block with a slight side-to-side twist.

NOTE: If the vane and vane switch assembly cannot be kept on the leading edge after installation, remove the distributor from the cylinder block by pulling upward enough for the distributor gear to disengage the distributor gear from the camshaft gear. Rotate the distributor rotor enough so that the gear will align on the next tooth of the camshaft gear.

6. Install the distributor hold-down clamp and bolt; leave it snug.

7. On V8 engines, position the adapter base in place, then install the attaching bolts.

8. Attach the electrical connector to the distributor.

9. Install the distributor cap. On 4.9L (VIN Y and Z) engines, tighten the distributor cap hold-down screws to 18-23 inch lbs. (2.0-2.6 Nm). Do

V8 engines, secure the distributor cap using the spring clips. If the spark plug wires were removed from the distributor cap, install them in their proper position, as marked during the removal procedure.

10. Connect the negative battery cable. Check the initial timing according to the proper procedure.

11. Adjust the timing, as necessary, then tighten the distributor hold-down bolt to 17-25 ft. lbs. (23-34 Nm).

Timing Disturbed

1. Disconnect the No. 1 spark plug wire and remove the No. 1 spark plug.

2. Place a finger over the spark plug hole and crank the engine slowly until compression is felt.

3. Align the TDC mark on the crankshaft pulley with the pointer on the timing cover. This places the No. 1 cylinder at TDC on the compression stroke.

4. Turn the distributor shaft until the rotor points to the No. 1 spark plug tower on the cap.

5. Install the distributor assembly into the engine block with a slight side-to-side twist.

NOTE: If the vane and vane switch assembly cannot be kept on the leading edge after installation, remove the distributor from the cylinder block by pulling upward enough for the distributor gear to disengage the distributor gear from the camshaft gear. Rotate the distributor rotor enough so that the gear will align on the next tooth of the camshaft gear.

6. Install the distributor hold-down clamp and bolt; leave it snug.

7. On V8 engines, position the adapter base in place, then install the attaching bolts.

8. Attach the electrical connector to the distributor.

9. Install the distributor cap. On 4.9L (VIN Y and Z) engines, tighten the distributor cap hold-down screws to 18-23 inch lbs. (2.0-2.6 Nm). On V8 engines, secure the distributor cap using the spring clips. If the spark plug wires were removed from the distributor cap, install them in their proper position, as marked during the removal procedure.

10. Connect the negative battery cable. Check the initial timing according to the proper procedure.

11. Adjust the timing, as necessary, then tighten the distributor hold-down bolt to 17-25 ft. lbs. (23-34 Nm).

Ignition Timing

ADJUSTMENT

NOTE: Always refer to the Vehicle Emission Information Label to verify the timing adjustment procedure and ignition specifics, which may have changed during the manufacture year.

Distributorless Ignition System

Base timing for distributorless engines is set from the factory at 10 degrees BTDC and is not adjustable.

Distributor Ignition System

1. Place automatic transmissions in P or manual transmissions in Neutral. The air conditioning and heater controls should be in the OFF position.

2. Connect a suitable inductive timing light and a tachometer according to the manufacturer's instructions.

3. Disconnect the single wire in-line spout connector or remove the shorting bar from the double wire spout connector.

4. Start the engine and bring it up to normal operating temperature.

NOTE: To set timing correctly, a remote starter should not be used. Use the ignition key only to start the vehicle. Disconnecting the start wire at the starter relay will cause the TFI module to revert to "start mode timing" after the vehicle is started. Reconnecting the start wire after the vehicle is running will not correct the timing.

5. With the engine running at the timing rpm specified, check the initial timing by aiming the timing light at the timing marks and pointer. Refer to the underhood Vehicle Emission Information Label for specific specifications.

6. If the marks do not align, shut the engine off and loosen the distributor hold-down clamp bolt. Start the engine, and while watching the timing marks with the timing light, turn the distributor until the marks are correctly aligned. Shut the engine off, then tighten the distributor hold-down clamp bolt to 17-25 ft. lbs. (23-34 Nm).

7. Reconnect the single wire in-line spout connector or reinstall the shorting bar on the double wire spout connector. Check the timing advance to verify the distributor is advancing beyond the initial setting.

8. Remove the timing light and tachometer.

Alternator

PRECAUTIONS

Several precautions must be observed with alternator equipped vehicles to avoid damage to the unit.

- If the battery is removed for any reason, make sure it is reconnected with the correct polarity. Reversing the battery connections may result in damage to the one-way rectifiers.

- When utilizing a booster battery as a starting aid, always connect the positive to positive terminals and the negative terminal from the booster battery to a good engine ground on the vehicle being started.

- Never use a fast charger as a booster to start vehicles.

- Disconnect the battery cables when charging the battery with a fast charger.

- Never attempt to polarize the alternator.

- Do not use test lights of more than 12V when checking diode continuity.

- Do not short across or ground any of the alternator terminals.

- The polarity of the battery, alternator and regulator must be matched and considered before making any electrical connections within the system.

- Never separate the alternator on an open circuit. Make sure all connections within the circuit are clean and tight.

- Disconnect the battery ground terminal when performing any service on electrical components.

- Disconnect the battery if arc welding is to be done on the vehicle.

REMOVAL AND INSTALLATION

1. Disconnect the negative battery cable.

2. Disconnect the electrical connectors from the alternator.

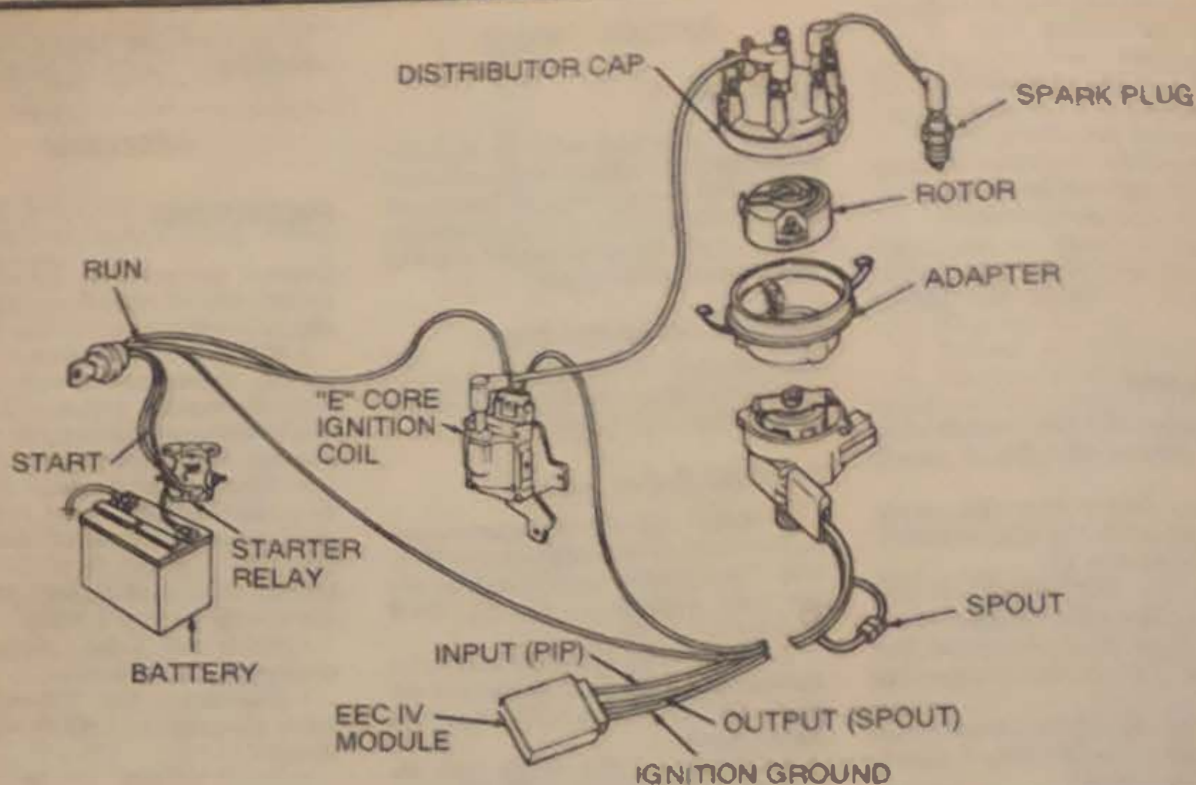
3. Remove the alternator drive belt.

4. Remove the pivot bolt and adjusting bolt, or the mounting bolts, then remove the alternator from the engine. Remove the alternator fan shield, if equipped.

To install:

5. Install the fan shield, if removed.

6. Situate the alternator in position, then install the applicable



Track Film Integrated (TFI) ignition system with universal distributor — 4.9L (VIN Y and Z), 5.0L (VIN N), 5.8L (VIN H and R) and 7.5L (VIN G) engines

mounting bolts. Tighten the bolts to the following values:

- 4.2L (VIN 2) Engine — 18-22 ft. lbs. (20-30 Nm)
- 4.6L Engines — 18-22 ft. lbs. (20-30 Nm)
- 4.9L (VIN Y and Z) and 7.5L (VIN G) Engines — 16-21 ft. lbs. (21-29 Nm)
- 5.0L (VIN N), 5.8L (VIN H and R) and 7.3L (VIN C, F, K, and M) (Except F-Super Duty) Engines — 16-21 ft. lbs. (21-29 Nm)
- 7.3L (VIN C, F, K, and M) (F-Super Duty) Engine — 30-41 ft. lbs. (40-55 Nm)

7. Install the alternator drive belt. On 7.3L (VIN C, F, K, and M) engines, properly tension the drive belt.

8. Attach all wiring harness electrical connections to the alternator.

NOTE: When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles (16 km) or more to relearn its strategy.

9. Connect the negative battery cable.

Drive Belt

REMOVAL AND INSTALLATION

Except 7.5L (VIN G) Alternator Belt

NOTE: All accessory drive belts, except for the alternator drive belt on 7.5L (VIN G) engines, are automatically tensioned. These belts do not require manual adjustment.

1. Using a box end wrench on the tensioner pulley bolt, lift the tensioner arm away from the belt.

2. Remove the old belt. Release the tensioner slowly. Do not allow the tensioner to snap back after the belt is removed because this may damage the tensioner.

To install:

WARNING

Make sure that the belt is properly seated on all pulleys. One revolution of the engine with an incorrectly seated belt may snap tensile members in the belt, thereby greatly weakening the drive belt.

3. Lift the tensioner arm, then install a new belt over the pulleys making sure that all belt ribs are correctly seated in the pulley.

4. Slowly allow the tensioner to take up all slack of the drive belt.

7.5L (VIN G) Alternator Belt

1. Loosen the alternator adjustment bolts and pivot bolt.

2. Remove the old belt from the pulleys.

To install:

3. Install the new belt onto the drive pulleys. Make certain that the belt is correctly seated on the pulleys.

4. Tension the drive belt as follows:

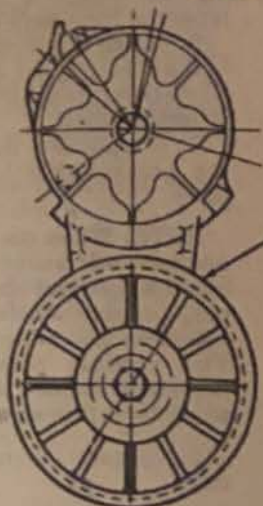
a. Use Rotunda Belt Tension Gauge 021-00019, or equivalent, for checking the tension.

b. Loosen the alternator adjustment bolts.

c. Tighten the pivot bolt enough to remove all free-play from the pivot area, but not enough to prevent the alternator from moving.

d. Place an adjustable wrench on the top lug of the alternator and rotate the alternator until the belt is tightened to the proper tension, which is 160-200 lbs. (711-869 N) for new belts or 110-130 lbs. (489-578 N) for used belts. Be sure to use the new belt tension for new belts and the used belt tension for used belts. A used belt is a belt

INDICATOR SHOULD BE BETWEEN MARKS



USE PULLEY BOLT ONLY TO RELIEVE BELT TENSION

Automatic belt tensioner — 4.9L (VIN Y and Z) engine

INDICATOR SHOULD BE BETWEEN MARKS



Automatic belt tensioner — 5.0L (VIN N) and 5.8L (VIN H and R) engines

Automatic belt tensioner — 5.0L (VIN N) and 5.8L (VIN H and R) engines

with more than 5 minutes of engine operation.

5. While maintaining the belt tension, tighten the adjustment bolt to 22-29 ft. lbs. (30-40 Nm) for E Series vehicles, and to 30-40 ft. lbs. (41-54 Nm) for F Series and Bronco vehicles.

6. Tighten the pivot bolt to 40-53 ft. lbs. (54-71 Nm).

7. Check and readjust the belt tension, if necessary.

8. Start the engine and allow it to idle for 5 minutes.

9. Recheck the belt tension.

10. If drive belt tension is less than the minimum after 5 minutes operation, then reset belt tension to the used belt tension value.

11. Start the engine again and allow it to idle to 5 minutes, then recheck the belt tension.

12. If the belt will not hold the correct tension, replace it with another one.

Starter

REMOVAL AND INSTALLATION

1. Disconnect the negative battery cable.

2. Raise the vehicle and support it safely.

3. Remove the starter motor solenoid terminal cover, if equipped.

4. Disconnect all wiring harness electrical connections from the starter motor.

5. Remove the starter mounting bolts and remove the starter.

To install:

6. Position the starter motor in place on the engine, then install the mounting bolts to 16-20 ft. lbs. (22-28 Nm).

7. Attach all electrical wiring harness connections to the starter motor.

8. Install the starter motor solenoid terminal cover, if applicable.

9. Lower the vehicle to the ground.

NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 10 miles (16 km) or more to relearn this strategy.

10. Connect the negative battery.

Diesel Glow Plugs

TESTING

CAUTION

The red-striped wiring harness carries 115v direct current. Severe electrical shock may be received. DO NOT pierce.

1. Turn the ignition switch OFF, then detach the electrical connectors from the glow plugs.

2. Using a test light, check for continuity between the glow plug terminal and a power source, with the glow plugs installed in the engine.

3. If there is no continuity, the glow plug must be replaced.

REMOVAL AND INSTALLATION

CAUTION

The red-striped wiring harness carries 115v direct current. Severe electrical shock may be received. DO NOT pierce.

1. Disconnect the negative battery cable.

2. Remove the rocker arm cover.

3. Disconnect the glow plug electrical leads using a pair of pliers.

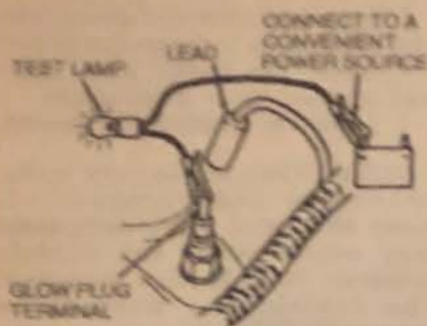
4. Remove the glow plugs by unscrewing them from the cylinder head with a 10mm socket and wrench.

5. Inspect the tips of the plugs for any evidence of distortion or missing tip ends; replace them if necessary.

To install:

6. Install the glow plug into the cylinder head. Tighten the glow plugs to 14 ft. lbs. (19 Nm).

7. Attach the glow plug electrical connector. Make sure that the glow plug wiring is routed to avoid moving components in the engine bay.



Diesel glow plug testing — 7.3L (VIN C, F, K, and M) engine

8. Install the rocker arm cover.

NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 10 miles (16 km) or more to relearn this strategy.

9. Connect the negative battery cable.

CHASSIS ELECTRICAL

Heater Blower Motor

REMOVAL AND INSTALLATION

Except 1997 F-150 and Expedition Models

1. Disconnect the battery ground.
2. On vehicles built for sale in California, remove the emission module located in front of the blower.
3. Disconnect the wiring harness at the blower.
4. Disconnect the blower motor cooling tube at the blower.
5. Remove the 3 blower motor mounting bolts.
6. Hold the cooling tube to one side and pull the blower motor from the housing.

To install:

7. Position the blower motor in the housing, then install the motor retaining bolts.
8. Install the blower motor cooling tube at the blower. Cement the cooling tube on the nipple at the housing using Liquid Butyl Sealer DBAZ-19554-A, or equivalent.

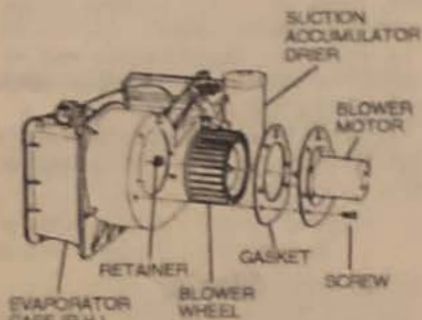
9. Attach the electrical wiring harness connector to the motor.
10. Install the emission module in front of the blower, if applicable.

NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 10 miles (16 km) or more to relearn this strategy.

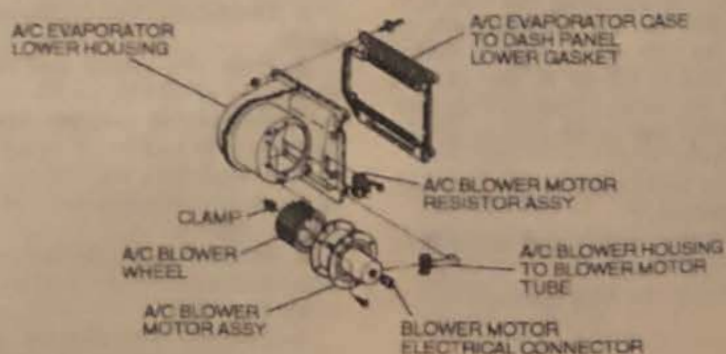
11. Connect the negative battery cable.

1997 F-150 and Expedition Models

1. Disconnect the negative battery cable.
2. If equipped, remove the aftermarket air filter.
3. If equipped, remove the mounting bracket for the removed cover.
4. Disconnect the Christmas tree retainer from the motor mounting plate.
5. Detach the electrical connector from the motor.
6. Remove the 3 blower motor cover mounting bolts, release the 3 retaining tabs, then remove the motor cover.



Blower motor and wheel installation — Bronco and F Series



Blower motor and wheel installation — E Series

7. Remove the 3 blower motor mounting screws, then carefully remove the motor.

To install:

8. Install the blower motor, then install the blower motor mounting screws until snug.
9. Install the blower motor cover by pressing in place until the retaining tabs engage it. Install the cover retaining bolts until snug.
10. Attach the electrical connection to the blower motor and reattach the Christmas tree retainer to the mounting plate.
11. If applicable, install the mounting bracket and aftermarket air filter.

NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 10 miles (16 km) or more to relearn this strategy.

12. Connect the negative battery cable.

Windshield Wiper Motor

REMOVAL AND INSTALLATION

Except 1997 F-150 and Expedition Models

1. Remove the wiper pivot arms.
2. Remove the bottom windshield moulding.
3. Remove the 5 screws through the access holes across the cowl top vent panel.
4. Open the hood and disconnect the negative battery cable.
5. Remove the 10 screws across the vertical surface attaching the cowl top vent panel to the cowl top.
6. Close the hood part way and carefully lift the cowl top vent panel.

7. Disconnect or remove the radio antenna or lead wire, as required.

8. Disconnect the washer hose. Remove the cowl top vent panel.

9. Remove the metal shield above the windshield wiper motor.

10. Remove the windshield wire adapter and connecting the arm clip connecting the windshield wiper mounting arm and pivot shaft to the windshield wiper motor drive arm.

11. Detach the electrical connector from the windshield wiper motor.

12. Remove the bolts attaching the windshield wiper motor to the cowl top.

13. Remove the windshield wiper motor from the vehicle.

To install:

14. Install the wiper motor in place, then install the retaining bolts to 60–85 inch lbs. (7–10 Nm).

15. Attach the electrical connector to the wiper motor.

16. Attach the windshield wiper mounting arm and pivot shaft to the windshield wiper motor drive arm.

17. Install the metal shield above the wiper motor.

18. Install the cowl top vent panel, then attach the washer hose.

19. Attach the radio antenna, if necessary.

20. Install the cowl top vent panel retaining fasteners until snug.

NOTE: When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles (16 km) or more to relearn the strategy.

21. Connect the negative battery cable.

22. Install the bottom windshield moulding.

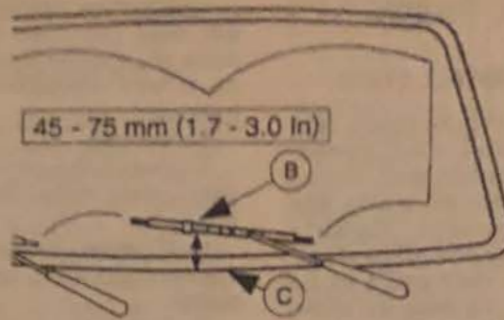
23. Before installing the wiper arms, cycle the windshield wiper motor using the wiper switch to make sure that the wiper linkage is in the Park position.

24. Install the wiper pivot arms.

1997 F-150 and Expedition Models

1. Disconnect the negative battery cable.

NOTE: The windshield wiper mounting arms and pivot shafts are serviced as an assembly.



7W21Ag11

If the left-hand wiper blade is not positioned within specification, reposition as shown — 1997 F-150 and Expedition models

2. Turn the ignition switch to the ON position.

3. Turn the windshield wiper switch on, then stop the windshield wiper pivot arms at the highest position by turning the ignition switch to the OFF position.

4. Remove the windshield wiper pivot arms as follows:

a. Remove the two pivot arm nut covers.

b. Remove the windshield wiper pivot arm retaining nuts.

c. Remove the windshield wiper pivot arms.

5. Remove the cowl top vent panels.

6. Remove the windshield wiper motor/linkage assembly as a unit as follows:

a. Detach the electrical connector from the wiper motor.

b. Remove the 3 assembly hold-down bolts.

c. Lift the windshield wiper motor/linkage assembly out of the cowl recess.

7. Remove the wiper linkage from the wiper motor by removing the linkage-to-motor shaft retaining bolt,

then detach the linkage arm from the motor shaft.

8. Remove the 3 wiper motor-to-motor/linkage assembly bolts, then pull the motor out of the assembly.

To install:

9. Situate the wiper motor in position in the motor/linkage assembly, then install the hold-down bolts to 10–12 ft. lbs. (13–17 Nm).

10. Attach the wiper linkage to the motor shaft and install the wiper linkage-to-motor shaft retaining nut to 11–14 ft. lbs. (15–20 Nm).

11. Set the wiper motor/linkage assembly into the windshield cowl recess, then secure with the 3 hold-down bolts to 62–80 inch lbs. (7–9 Nm). Attach the wiper motor electrical connector.

12. Install the cowl top vent panels.

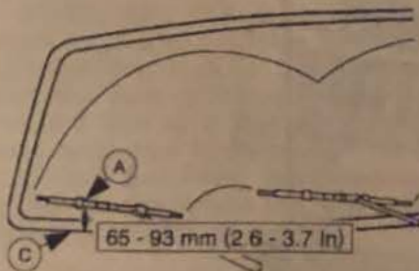
13. Install the wiper arms in the same position as when removed. Install the wiper arm-to-wiper motor shaft nut to 23–29 ft. lbs. (30–40 Nm).

14. Turn the ignition switch ON to cycle the wiper arms to the Park position to assure that the wiper arms are installed in the correct position. Turn the wiper switch Off once the wipers are in the Park position.

15. Measure from the center of the left-hand wiper blade to the bottom edge of the windshield moulding. The distance should be 2.6–3.7 in. (65–93mm). Measure the same distance on the right-hand wiper blade. The right-hand wiper blade distance should be 1.7–3.0 in. (45–75mm) above the bottom edge of the windshield moulding.

16. If the distances are not within specifications, reposition the wiper arms on the wiper motor shafts.

17. Connect the negative battery cable.



7W21Ag11

Make certain to position the left-hand wiper blade as shown — 1997 F-150 and Expedition models

Headlight Switch

REMOVAL AND INSTALLATION

NOTE: When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles (16 km) or more to relearn the strategy.

Except 1997 F-150 and Expedition Models

1. Disconnect the battery ground cable.
2. Depending on the year and model remove the wiper-washer and fog lamp switch knob if they will interfere with the headlight switch knob removal. Check the switch body (behind dash, see Step 3) for a release button. Press in on the button and remove the knob and shaft assembly. If not equipped with a release button, a hook tool may be necessary for knob removal.
3. Remove the steering column shrouds and cluster panel finish panel if they interfere with the required clearance for working behind the dash.

4. Unscrew the switch mounting nut from the front of the dash. Remove the switch from the back of the dash and disconnect the wiring harness.

To install:

5. Install the switch into the dash panel, then install the switch mounting nut.
6. If necessary, install the steering column shrouds or cluster finish panel.
7. Install the wiring to the switch, then install the switch knob.
8. Connect the negative battery cable.

1997 F-150 and Expedition Models

1. Disconnect the negative battery cable.
2. Turn the head lamp switch knob to the head lamp position and pull the knob.
3. Insert a thin tool under the backside of the switch knob (opposite end of switch knob from the indicator mark) to release the head lamp switch knob and remove.
4. Turn the head lamp switch knob 180 degrees and reinstall onto the switch.
5. Turn the knob, now reinstalled, counterclockwise until the back of the

head lamp switch knob is in the OFF position.

6. Turn the head lamp switch knob clockwise 360 degrees (one full turn).

7. Pull the head lamp from the instrument panel.

8. Detach the electrical connectors from the switch.

To install:

9. Attach the electrical connectors to the head lamp switch, then press it into the dash panel.

10. Turn the switch knob counterclockwise 360 degrees (one full turn).

11. Turn the switch knob clockwise until the back of the knob is facing the ON position.

12. Once again remove the switch knob from the switch, rotate the knob 180 degrees and reinstall onto the switch (the indicator mark should now be facing the on position).

13. Turn the head lamp switch to the off position.

14. Connect the negative battery cable.

Combination Switch

REMOVAL AND INSTALLATION

NOTE: When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles (16 km) or more to relearn the strategy.

1997 F-150 and Expedition Models

1. Disconnect the negative battery cable.

2. Insert the ignition key into the ignition switch lock cylinder and turn to the RUN position.

3. Push the ignition switch lock cylinder release tab with a punch while pulling out the ignition switch lock cylinder.

4. If equipped, twist the tilt wheel handle and shank, then remove it.

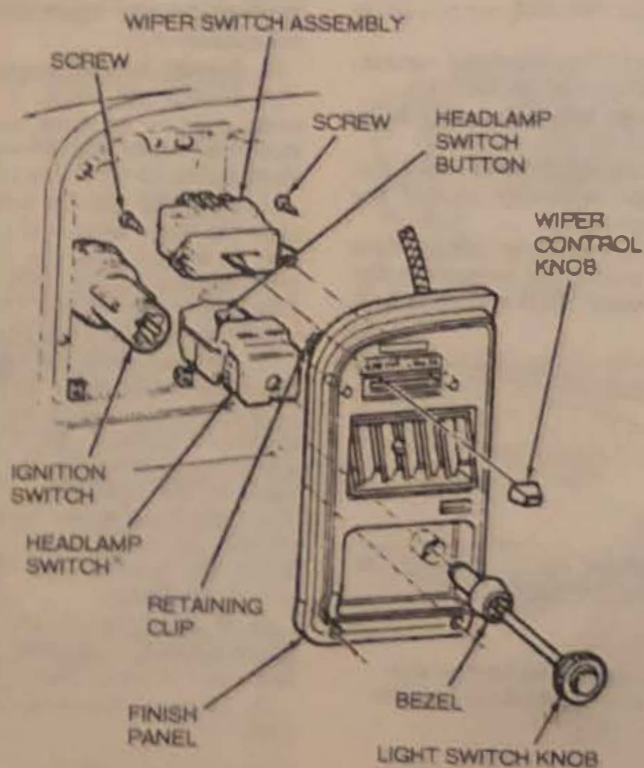
5. Remove the upper and lower steering column shrouds by removing the 3 retaining screws.

6. Remove the 2 multi-function switch retaining screws (1), then detach the electrical connectors (2) from the switch (3).

7. Remove the switch from the steering column.

To install:

8. Attach the electrical connectors to the switch, position the switch on the steering column, then install the



Headlight switch — 1993-96 E Series models

Ignition Lock Cylinder



The combination switch is mounted to the side of the steering column by 2 retaining screws — 1997 F-150 and Expedition models

retaining screws to 19–25 inch lbs. (2.1–2.9 Nm).

9. Install the upper and lower steering column shrouds.

10. Install the tilt wheel handle and shank, if removed.

11. With the ignition key in the lock cylinder, and in the RUN position, push the ignition lock cylinder back into the cylinder mounting recess.

12. Turn the ignition switch OFF and remove the ignition key.

13. Connect the negative battery cable.

Except 1997 F-150 and Expedition Models

1. Disconnect the battery ground cable.

2. Remove the steering column shroud.

3. Remove the 2 self-tapping screws that attach the combination switch to the steering column tube casting. Disengage the combination switch from the casting.

4. Detach the 2 electrical connectors from the switch, using caution not to damage the locking tabs. Do not damage the PRNDL cable.

To install:

5. Install the 2 switch electrical connectors to full engagement. The wiring for the switch is to be routed under the PRNDL cable.

6. Align the mounting holes on the combination switch with the holes in the steering column tube casting. Install 2 self-tapping screws making sure to start the screws in the previously tapped holes.

7. For vehicles equipped with automatic transmissions, verify that the PRNDL adjustment is correct.

8. Connect the battery cable.

9. Check the steering column tube for proper operation.

10. Install the steering column shroud.

REMOVAL AND INSTALLATION

NOTE: When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles (16 km) or more to relearn the strategy.

All Models

Functional Cylinder

1. Disconnect the negative battery cable.

2. Insert the ignition key into the ignition switch lock cylinder and turn to the RUN position.

3. Push the ignition switch lock cylinder release tab/pin with a punch while pulling out the ignition switch lock cylinder.

To install:

4. While depressing the release tab/pin and with the ignition key in the lock cylinder in the RUN position, push the ignition lock cylinder back into the cylinder mounting recess. Make sure that the ignition switch lock cylinder is fully seated and aligned in the interlocking washer before turning the ignition key OFF. This will permit the retaining pin of the ignition switch lock cylinder to extend into the hole in the steering column.

5. Turn the ignition switch OFF. Make sure that the ignition lock moves to all positions and functions properly, then remove the ignition key.

6. Connect the negative battery cable.

Non-Functional Cylinder

NOTE: The following procedure applies to vehicles in which the ignition lock is inoperative and the lock cylinder cannot be rotated due to a lost or broken key, unknown key number, or a cap that has been damaged or broken to the extent that the lock cylinder cannot be rotated.

1. Disconnect the negative battery cable.

2. Remove the steering wheel.

3. Using a pair of pliers, or similar tool, twist (clockwise direction) the cap off of the ignition switch lock cylinder.

4. Use a 3/8 in. diameter drill bit to drill down the middle of the ignition

lock key slot until the ignition switch lock cylinder breaks loose.

5. Remove and discard the old ignition lock cylinder. Clean all drill shavings from the steering column.

6. Remove the bearing retainer.

7. Remove the bearing and gear from the steering column. Thoroughly clean all drill shavings from the steering column and inspect the bore for any damage.

To install:

8. Install the gear and bearing into their original positions. Install the bearing retainer.

9. Install a new ignition lock cylinder by inserting it into the bore until engaged fully.

10. Install the steering wheel.

11. Connect the negative battery cable.

Ignition Switch

REMOVAL AND INSTALLATION

NOTE: When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles (16 km) or more to relearn the strategy.

1997 F-150 and Expedition Models

1. Disconnect the negative battery cable.

2. Release the 4 clips, then remove the steering column opening cover.

3. Release the 3 clips, then remove the lower instrument panel steering column.

4. Remove the hood latch mounting screws, then position the hood latch handle aside.

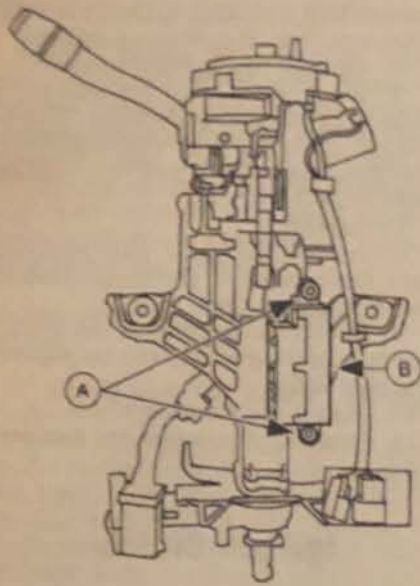
5. Remove the parking brake release handle mounting screws. Position the parking brake release handle aside.

6. Remove the 2 push clips and release the one expander clip to remove the instrument panel floor duct panel.

7. Remove the 6 upper instrument panel steering column cover retaining bolts, then remove the panel.

8. Remove the ignition switch electrical harness connector retaining bolt, then pull the connector from the switch.

9. Remove the 2 switch retaining screws (A) and pull the switch (B) from the steering column.



The ignition switch is secured to the steering column assembly by 2 retaining screws — 1997 F-150 and Expedition models

To install:

10. Position the ignition switch in place, then install the 2 retaining screws until snug.
11. Attach the switch electrical harness connector and install the connector-to-switch retaining bolt until secure.
12. Install the instrument panel steering column cover and the instrument panel floor duct panel.
13. Position the parking brake release handle in its original position, then secure in place with the retaining screws. Perform the same with the hood latch handle.
14. Install the lower instrument panel steering column until the 3 clips engage fully. Install the steering column opening cover in the same manner.
15. Connect the negative battery cable.

Except 1997 F-150 and Expedition Models

1. Disconnect the battery ground cable.
2. Remove the steering column shroud and lower the steering column.
3. Disconnect the switch wiring at the multiple plug.

4. Remove the two nuts that retain the switch to the steering column.

5. Lift the switch vertically upward to disengage the actuator rod from the switch and remove the switch.

6. When installing the ignition switch, both the locking mechanism at the top of the column and the switch itself must be in the LOCK position for correct adjustment. To hold the mechanical parts of the column in the LOCK position, move the shift lever into P (with automatic transmissions) or REVERSE (with manual transmissions), turn the key to the LOCK position, and remove the key. New replacement switches, when received, are already pinned in the LOCK position by a metal shipping pin inserted in a locking hole on the side of the switch.

7. Engage the actuator rod in the switch.

8. Position the switch on the column and install the retaining nuts, but do not tighten them.

9. Move the switch up and down along the column to locate the mid-position of rod lash, and then tighten the retaining nuts.

10. Remove the locking pin, connect the battery cable, and check for proper start in P or NEUTRAL. Also check to make certain that the start circuit cannot be actuated in the D and R position.

11. Raise the steering column into position at instrument panel. Install steering column shroud.

Park/Neutral Safety Switch

REMOVAL AND INSTALLATION

NOTE: On Ford vehicles, the Park/Neutral Safety Switch is referred to as the Transmission Range (TR) sensor. Although given a different designation, the TR performs the same job as the Park/Neutral Safety Switch.

1997 F-150 and Expedition Models

1. Disconnect the negative battery cable.
2. Raise and support the vehicle safely on jackstands.
3. Disconnect the shift cable from the transmission.
4. Place the transmission in Neutral.
5. Remove and discard the manual control lever nut, then remove the lever from the transmission.

6. Detach the TR sensor electrical harness connector, remove the TR sensor retaining bolts, then pull the TR sensor off of the transmission case.

To install:

7. Position the TR sensor against the transmission case and loosely install the 2 retaining screws.

8. Attach the TR sensor electrical harness connector.

9. Use an alignment tool (A), such as the TR Sensor Alignment Tool T93P-70010-A, to align the TR sensor slots (B).

10. Tighten the TR sensor bolts to 62–89 inch lbs. (7–10 Nm).

11. Position the manual control lever onto the TR sensor, then install the NEW lever nut to 22–26 ft. lbs. (30–35 Nm).

12. Connect the shift cable.

13. Lower the vehicle.

14. Connect the negative battery cable.

Except 1997 F-150 and Expedition Models

C8 Transmission

1. Disconnect the negative battery cable.
2. Raise and support the vehicle safely on jackstands.
3. Remove the downshift linkage rod return spring at the low-reverse servo cover.
4. Coat the outer lever attaching nut with penetrating oil. Remove the nut and lever.
5. Note or matchmark the position of the switch.
6. Remove the 2 switch attaching bolts, disconnect the wiring at the connectors and remove the switch.

To install:

7. Attach the switch wiring connector to the switch, then install the switch itself in the original position. Tighten the switch bolts to 55–75 inch lbs. (6.1–8.4 Nm).
8. Install the outer lever and attaching nut.
9. Install the downshift linkage return spring.
10. Lower the vehicle.
11. Connect the negative battery cable.

AOD Transmission

1. Disconnect the negative battery cable.
2. Raise and support the vehicle safely on jackstands.
3. Disconnect the wiring from the switch.
4. Using a deep socket, unscrew the switch.

To install:

5. Thread the switch into the transmission by hand until the threads are started. Tighten the switch to 10 ft. lbs. (14 Nm).

6. Attach the switch wiring connector, then lower the vehicle.

7. Connect the negative battery cable.

Powertrain Control Module (PCM)

REMOVAL AND INSTALLATION

1997 F-150 and Expedition Models

WARNING

Always disconnect the battery ground cable prior to work on the electronic engine control components.

1. Disconnect the negative battery cable.

2. Loosen the PCM electrical connector retaining bolt and separate the connector from the PCM.

3. Remove the right-hand front door scuff plate.

4. Remove the right-hand cowl side trim panel.

5. Remove the PCM bracket clip.

6. Remove the PCM from the vehicle.

To install:

7. Situate the PCM in position in the vehicle, then secure in the PCM bracket clip.

8. Install the cowl side trim panel and the front door scuff plate.

9. Attach the electrical connector to the PCM, then install and tighten the connector-to-PCM retainer bolt to 46-64 inch lbs. (5.2-7.2 Nm).

10. Connect the negative battery cable.

Except 1997 F-150 and Expedition Models

1. Disconnect the negative battery cable.

2. Loosen the PCM electrical connector retaining bolt and separate the connector from the PCM.

3. Remove the 2 PCM seal nuts and loosen the left fender liner screws. Remove the fender liner or bend it down out of the way to clear the PCM.

4. Remove the PCM from the vehicle.

To install:

5. Situate the PCM in position in the vehicle, then install the fender liner.

6. Install the 2 PCM seal nuts.

7. Attach the electrical connector to the PCM, then install and tighten the connector-to-PCM retainer bolt to 35 inch lbs. (4 Nm).

8. Connect the negative battery cable.

ENGINE COOLING

Radiator

REMOVAL AND INSTALLATION

NOTE: When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles (16 km) or more to relearn the strategy.

NOTE: Two special tools will be needed for the following procedure. These tools are the Fan Clutch Holding Tool T84T-6312-C and Fan Clutch Wrench T93T-6312-B, or their equivalents.

1. Disconnect the negative battery cable.

2. Drain the cooling system.

3. Remove the front air deflector.

4. Remove the upper radiator hose from the radiator.

5. Remove the radiator coolant recovery reservoir hose from the radiator.

NOTE: The fan clutch has left-hand (reverse) threads.

6. Use the fan clutch holding tool to hold the water pump pulley steady, then remove the fan blade and fan clutch with the fan clutch wrench.

7. Separate the fan clutch from the fan blade assembly.

8. Remove the 2 fan shroud screws, then lift the fan shroud out of the engine compartment.

9. If necessary, disconnect the upper and lower transmission cooler lines from the radiator. Plug the open ends of the lines.

10. Remove the lower radiator hose from the radiator.

11. Remove the 2 upper radiator support bracket bolts. Remove the 2 upper radiator support brackets and the 2 jack handle and wheel nut wrench retainers.

12. Lift the radiator off of the mounting insulators, then remove the insulators themselves.

To install:

13. Install the 2 radiator mounting insulators, then position the radiator on the insulators. Position the 2 upper radiator support brackets and the 2 jack handle and wheel nut wrench retainers. Install the 2 upper radiator support bracket bolts to 18-26 ft. lbs. (25-35 Nm).

14. Connect the lower radiator hose to the radiator.

15. If applicable, connect the lower and upper transmission cooler lines to the radiator. Tighten the fittings to 12-18 ft. lbs. (16-24 Nm).

16. Lower the fan shroud onto the radiator clips, then install the two fan shroud retainer screws until snug.

17. Position the fan clutch on the fan blade assembly, then install the 4 fan clutch bolts to 11-15 ft. lbs. (15-20 Nm).

NOTE: The fan clutch has left-hand threads.

18. Position the fan clutch/blade assembly on the water pump pulley. Using the two special tools, install the fan clutch/blade assembly to the water pump pulley.

19. Push the radiator coolant recovery reservoir hose onto the radiator fitting, then position and tighten the hose clamp.

20. Connect the upper radiator hose to the radiator.

21. Install the front air deflector. Fill the cooling system.

22. Connect the negative battery cable, then start the engine and check for coolant leaks.

Water Pump

REMOVAL AND INSTALLATION

NOTE: When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles (16 km) or more to relearn the strategy.

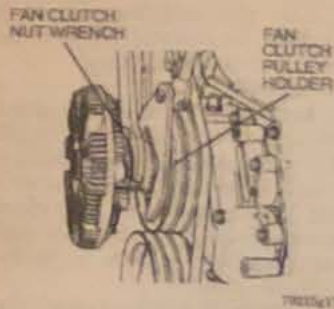
4.2L (VIN 2) Engine

1. Disconnect the negative battery cable.

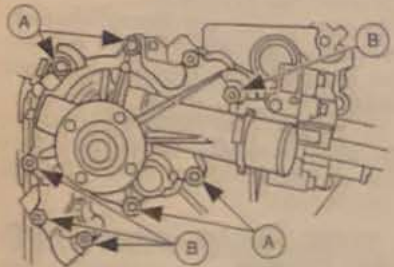
2. Remove the radiator, fan blade assembly and fan shroud.

3. Remove the accessory drive belt.

5 FORD MOTOR CO. BRONCO/E-SERIES VAN/EXPEDITION



Fan and clutch assembly removed — 7.5L (VIN C, F, K, and M) Diesel engine shown, other engines similar



Note the locations of the water pump mounting bolts (A) and nuts (B) — 4.2L (VIN 2) engines

4. Remove the water pump pulley.
5. Remove the heater water outlet tube by removing the wiring harness, then the hold-down bolt.
6. Remove the 4 water pump bolts and the 4 water pump nuts.
7. Remove the water pump stud bolt, the water pump and the water pump housing gasket. Discard the water pump housing gasket.

To install:

8. Before water pump installation, make sure to aptly clean the water pump mounting surfaces of all dirt, grime and old gasket material.

NOTE: All water pump housing bolts, nuts and studs are tightened to 15–22 ft. lbs. (20–30 Nm).

9. Install the water pump onto the engine with a new gasket. Install the water pump stud bolt temporarily finger-tight.

10. Install the water pump mounting nuts and bolts temporarily finger-tight, then tighten all water pump housing fasteners to the correct torque specification in a crisscross fashion.

11. Install the heater water outlet tube, then install and tighten the hold-down bolt to 71–97 inch lbs. (8–11 Nm). Install the wiring harness.

12. Install the water pump pulley and tighten the 4 mounting bolts to 16–21 ft. lbs. (21–29 Nm).

13. Install the accessory drive belt.

14. Install the fan shroud, fan blade assembly and the radiator. Fill the cooling system, then connect the negative battery cable.

4.6L Engines (VIN W and VIN 6)

1. Disconnect the negative battery cable.

2. Remove the fan blade assembly and fan shroud.

3. Remove the accessory drive belt.

4. Remove the water pump pulley.

5. Remove the 4 water pump bolts.

6. Remove the water pump from the engine block. Clean and inspect the mating surfaces.

To install:

7. Before water pump installation, make sure to aptly lubricate and install the O-ring seal.

NOTE: All water pump housing and water pump pulley bolts are tightened to 15–22 ft. lbs. (20–30 Nm).

8. Position the water pump on the engine and loosely install the 4 mounting bolts.

9. Tighten the water pump housing fasteners to the specified value in a clockwise fashion, starting with the uppermost bolt.

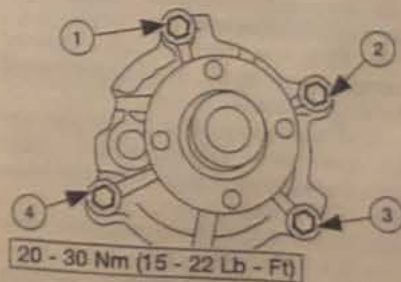
10. Install the water pump pulley and also tighten the 4 pulley mounting bolts to the specified value in a clockwise fashion, starting with the right-hand bolt.

11. Install the accessory drive belt.

12. Install the fan shroud and fan blade assembly. Fill the cooling system, then connect the negative battery cable.

4.9L (VIN Y and Z) Engine

1. Drain the cooling system.



Make sure to tighten the water pump bolts in the sequence shown — 4.6L engines (VIN W and VIN 6)

2. Disconnect the lower radiator hose from the water pump.

3. Remove the drive belt, fan, fan spacer, fan shroud, if equipped, and water pump pulley.

4. Remove the alternator pivot arm from the pump.

5. Disconnect the heater hose at the water pump.

6. Remove the water pump.

To install:

7. Before installing the old water pump, clean the gasket mounting surfaces on the pump and on the cylinder block. If a new water pump is being installed, remove the heater hose fitting from the old pump and install it on the new one.

8. Coat the new gaskets with sealer on both sides and install the water pump. Torque the mounting bolts to 18 ft. lbs. (25 Nm).

9. Connect the heater hose at the water pump.

10. Install the alternator pivot arm on the pump.

11. Install the water pump pulley, fan shroud, fan spacer, fan, and drive belt.

12. Connect the lower radiator hose at the water pump.

13. Fill the cooling system.

5.0L (VIN N), 5.8L (VIN H and R) and 7.5L (VIN G) Engines

1. Drain the cooling system.

2. Remove the bolts securing the fan shroud to the radiator, if equipped, and position the shroud over the fan.

3. Disconnect the lower radiator hose, heater hose and by-pass hose at the water pump. Remove the drive belts, fan, fan spacer and pulley. Remove the fan shroud, if equipped.

4. Loosen the alternator pivot bolt and the bolt attaching the alternator adjusting arm to the water pump. Remove the power steering pump bracket from the water pump and position it out of the way.

5. Remove the bolts securing the water pump to the timing chain cover and remove the water pump.

To install:

6. Coat a new gasket with sealer and install the water pump. Torque the bolts to 18 ft. lbs. (25 Nm).

7. Install the power steering pump bracket.

8. Connect the lower radiator hose, heater hose and by-pass hose at the water pump.

9. Install the fan shroud, if equipped.

10. Install the pulley, fan spacer, fan, and drive belts.

11. Fill the cooling system.

7.3L (VIN C, F, K, and M) Diesel Engine

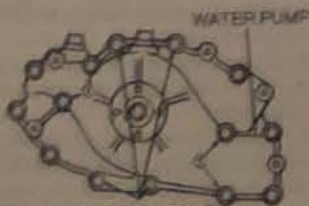
1. Disconnect both battery ground cables.
2. Drain the cooling system.
3. Remove the radiator shroud halves.
4. Remove the fan clutch and fan.

NOTE: The fan clutch bolts are left hand thread. Remove them by turning them clockwise.

5. Remove the power steering pump belt.
6. Remove the air conditioning compressor belt.
7. Remove the vacuum pump drive belt.
8. Remove the alternator drive belt.
9. Remove the water pump pulley.
10. Disconnect the heater hose at the water pump.
11. If installing a new pump, remove the heater hose fitting from the old pump.
12. Remove the alternator adjusting arm and bracket.
13. Unbolt the air conditioning compressor and position it out of the way; do not disconnect the refrigerant lines!
14. Remove the air conditioning compressor brackets.
15. Unbolt the power steering pump and bracket and position it out of the way; do not disconnect the power steering fluid lines.
16. Remove the bolts attaching the water pump to the front cover and lift off the pump.

To install:

17. Thoroughly clean the mating surfaces of the pump and front cover.
18. Obtain 2 dowel pins, anything that will fit into 2 mounting bolt holes in the front cover, when installing the water pump.
19. Using a new gasket, position the water pump over the dowel pins and into place on the front cover.



APPLY AVIATION PERMATEX®
NO. 3 OR EQUIVALENT
TO THESE BOLTS

5 THESE BOLTS 2 3/4 IN. LONG
ALL OTHERS ARE 1 1/2 IN. LONG

Water pump — 7.3L (VIN C, F, K, and M)
Diesel engine

20. Install the attaching bolts. The 2 top center and 2 bottom center bolts must be coated with RTV silicone sealant prior to installation. Also, the 4 bolts marked No. 1 are a different length than the other bolts. Torque the bolts to 14 ft. lbs. (19 Nm).
21. Install the water pump pulley.
22. Wrap the heater hose fitting threads with Teflon® tape and screw it into the water pump. Torque it to 18 ft. lbs. (25 Nm).
23. Connect the heater hose to the pump.
24. Install the power steering pump and bracket. Install the belt.
25. Install the air conditioning compressor bracket.
26. Install the air conditioning compressor. Install the belt.
27. Install the alternator adjusting arm and install the belt.
28. Install the vacuum pump drive belt.
29. Adjust all the drive belts.
30. Install the fan and clutch. Remember that the bolts are left hand thread. Turn them counterclockwise to tighten them. Torque them to 45 ft. lbs. (61 Nm).
31. Install the fan shroud halves.
32. Fill and bleed the cooling system.
33. Connect the battery ground cables.
34. Start the engine and check for leaks.

Thermostat

NOTE: It is a good practice to check the operation of a new thermostat before it is installed in an engine. Place the thermostat in a pan of boiling water. If it does not open more than 1/4 in. (6mm), do not install it in the engine.

REMOVAL AND INSTALLATION

NOTE: When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles (16 km) or more to relearn the strategy.

4.2L (VIN 2) Engine

1. Partially drain the cooling system.
2. Remove the upper radiator hose.

3. Remove the water thermostat and gasket assembly as follows:

- a. Remove the 2 water outlet connection bolts.
- b. Remove the water outlet connection.
- c. Remove the water thermostat and gasket assembly.

To install:

4. Clean all gasket surfaces of dirt, grime or old gasket material.
5. Install the water thermostat as follows:

- a. Align the notch in the water thermostat and gasket assembly with the recess in the water outlet connection.

- b. Position the water outlet connection on the lower intake manifold.

- c. Install the 2 water outlet connection bolts to 71-102 inch lbs. (8.0-11.5 Nm).

6. Connect the upper radiator hose.

7. Fill the cooling system, start the engine and check for leaks.

4.6L Engines (VIN W and VIN 6)

1. Partially drain the cooling system.

2. Remove the upper radiator hose.

3. Remove the water outlet connection as follows:

- a. Remove the 2 water outlet connection bolts.

- b. Remove the water outlet connection.

- c. Remove the water thermostat and O-ring. Discard the O-ring.

To install:

4. Clean all gasket surfaces of dirt or grime.

5. Using a new O-ring (A), position the water thermostat (B) in the lower intake manifold (C).

6. Position the water outlet connection on the lower intake manifold. Install the 2 water outlet connection bolts to 15-22 ft. lbs. (20-30 Nm).

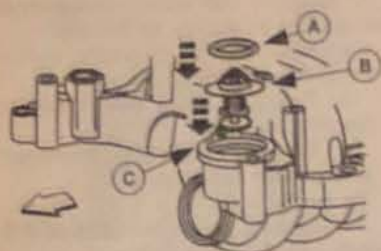
7. Connect the upper radiator hose.

8. Fill the cooling system, start the engine and check for leaks.

4.9L (VIN Y and Z) Engine

1. Drain the cooling system below the level of the coolant outlet housing. Use the petcock valve at the bottom of the radiator to drain the system. It is not necessary to remove any of the hoses.

2. Remove the coolant outlet housing retaining bolts and slide the housing with the hose attached to one side.



Install a new thermostat (B) in the lower intake manifold (C). Then install a new O-ring (A) — 4.6L engines (VIN W and VIN 6)

3. Remove the thermostat and gasket from the cylinder head and clean both mating surfaces.

To install:

4. Coat a new gasket with water resistant sealer and position it on the outlet of the engine. The gasket must be in place before the thermostat is installed.

5. Install the thermostat with the bridge (opposite end of the spring) inside the elbow connection.

6. Position the elbow connection onto the mounting surface of the outlet, so the thermostat flange is resting on the gasket and install the retaining bolts. Torque the bolts to 15 ft. lbs. (20 Nm).

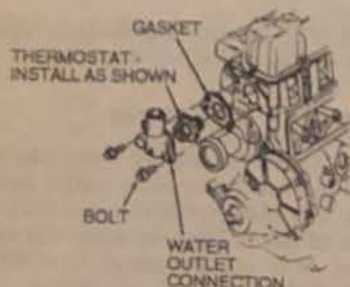
7. Fill the radiator and operate the engine until it reaches operating temperature. Check the coolant level and adjust if necessary.

5.0L (VIN N), 5.8L (VIN H and R) and 7.5L (VIN G) Engines

1. Drain the cooling system below the level of the coolant outlet housing. Use the petcock valve at the bottom of the radiator to drain the system. It is not necessary to remove any of the hoses.

2. Disconnect the bypass hoses at the water pump and intake manifold.

3. Remove the bypass tube.



Exploded view of the thermostat and related components found on the 4.9L (VIN Y and Z) engine

4. Remove the coolant outlet housing retaining bolts, bend the hose and lift the housing with the hose attached to one side.

5. Remove the thermostat and gasket from the intake manifold and clean both mating surfaces.

To install:

6. To install the thermostat, coat a new gasket with water resistant sealer and position it on the outlet of the engine. The gasket must be in place before the thermostat is installed.

7. Install the thermostat with the bridge (opposite end of the spring) inside the elbow connection and the thermostat flange positioned in the recess in the manifold.

8. Position the elbow connection onto the mounting surface of the outlet. Torque the bolts to 18 ft. lbs. (25 Nm) on the 5.0L (VIN N) and 5.8L (VIN H and R) engines, or to 28 ft. lbs. (38 Nm) on the 7.5L (VIN G) engine.

9. Install the bypass tube and hoses.

10. Fill the radiator and operate the engine until it reaches operating temperature. Check the coolant level and adjust if necessary.

7.3L (VIN C, F, K, and M) Diesel Engine

WARNING

The factory specified thermostat does not contain an internal bypass. On these engines, an internal bypass is located in the block. The use of any replacement thermostat other than that meeting the manufacturer's specifications will result in engine overheating! Use only thermostats meeting the specifications of Ford part number E5TZ-8575-C or Navistar International part number 1807945-C1.

1. Disconnect both battery ground cables.

2. Drain the coolant to a point below the thermostat housing.

3. Remove the alternator and vacuum pump belts.

4. Remove the alternator.

5. Remove the vacuum pump and bracket.

6. Remove all but the lowest vacuum pump/alternator mounting casting bolt.

7. Loosen that lowest bolt and pivot the casting outboard of the engine.

8. Remove the thermostat housing attaching bolts, bend the hose and lift the housing up and to one side.

9. Remove the thermostat and gasket.

To install:

10. Clean the thermostat housing and block surfaces thoroughly.

11. Coat a new gasket with water-proof sealer and position the gasket on the manifold outlet opening.

12. Install the thermostat in the manifold opening with the spring element end downward and the flange positioned in the recess in the manifold.

13. Place the outlet housing into position and install the bolts. Torque the bolts to 20 ft. lbs. (27 Nm).

14. Reposition the casting.

15. Install the vacuum pump and bracket.

16. Install the alternator.

17. Adjust the drive belts.

18. Fill and bleed the cooling system.

19. Connect both battery cables.

20. Run the engine and check for leaks.

Cooling System Bleeding

When the entire cooling system is drained, the following procedure should be used to remove air from the cooling system and ensure a complete fill.

1. Close the radiator drain cock and install the cylinder block drain plug, if removed.

2. Fill the cooling system with a 50/50 mixture of anti-freeze and water. Allow several minutes for trapped air to escape. When filling a cross flow radiator, allow time for the coolant to flow through the radiator tubes to the other end of the tank to ensure the radiator is full.

3. Install the radiator cap to the pressure relief position by installing the cap to the fully installed position and then backing off to the 1st stop. This will allow any air to escape and will minimize spillage.

4. Slide the heater temperature and mode selection levers to the maximum heat position.

5. Start the engine and allow to operate at fast idle for approximately 3-4 minutes.

6. With the engine shut off, wrap the radiator cap with a thick cloth, carefully remove the cap and add coolant to bring the coolant level up to the filler neck seat.

7. Install the cap to the fully installed position. Then, back off to the 1st stop and operate the engine at fast idle until the thermostat opens and the upper radiator hose is warm. To check the coolant level, shut the

engine off, wrap the cap with a thick cloth and cautiously remove the cap. Add additional coolant, if necessary. Install the cap to the fully installed position.

CAUTION

To avoid personal injury from scalding hot coolant or steam blowing out of the radiator, use extreme care when removing the cap from a hot radiator.

8. Fill the coolant recovery reservoir to the proper level with a 50/50 mix of anti-freeze and water.

GASOLINE FUEL SYSTEM

Fuel System Service Precautions

Safety is the most important factor when performing not only fuel system maintenance but any type of maintenance. Failure to conduct maintenance and repairs in a safe manner may result in serious personal injury or death. Maintenance and testing of the vehicle's fuel system components can be accomplished safely and effectively by adhering to the following rules and guidelines.

- To avoid the possibility of fire and personal injury, always disconnect the negative battery cable unless the repair or test procedure requires that battery voltage be applied.
- Always relieve the fuel system pressure prior to disconnecting any fuel system component (injector, fuel rail, pressure regulator, etc.), fitting or fuel line connection. Exercise extreme caution whenever relieving fuel system pressure to avoid exposing skin, face and eyes to fuel spray. Please be advised that fuel under pressure may penetrate the skin or any part of the body that it contacts.
- Always place a shop towel or cloth around the fitting or connection prior to loosening to absorb any excess fuel due to spillage. Ensure that all fuel spillage (should it occur) is quickly removed from engine surfaces. Ensure that all fuel soaked cloths or towels are deposited into a suitable waste container.

- Always keep a dry chemical (Class B) fire extinguisher near the work area.

- Do not allow fuel spray or fuel vapors to come into contact with a spark or open flame.

- Always use a backup wrench when loosening and tightening fuel line connection fittings. This will prevent unnecessary stress and torsion to fuel line piping. Always follow the proper torque specifications.

- Always replace worn fuel fitting O-rings with new. Do not substitute fuel hose or equivalent where fuel pipe is installed.

RELIEVING FUEL SYSTEM PRESSURE

NOTE: A fuel pressure gauge, such as Ford Tool T80L-9974-B, is needed to correctly perform this procedure.

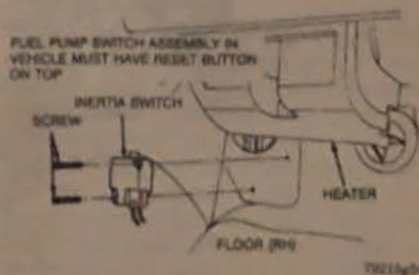
1. Disconnect the negative battery cable and remove the fuel filler cap.
2. Remove the cap from the pressure relief valve on the fuel supply manifold. Install pressure gauge T80L-9974-B or equivalent, to the pressure relief valve.
3. Direct the gauge drain hose into a suitable container and depress the pressure relief button.
4. Remove the gauge and replace the cap on the pressure relief valve.

NOTE: As an alternate method on models except 1997 F-150 and Expedition, disconnect the inertia switch and crank the engine for 15-20 seconds until the pressure is relieved.

Idle Speed and Mixture

ADJUSTMENT

The curb idle and fast idle speeds are controlled by the Powertrain Control



Typical inertia switch location — this method of fuel pressure relief is not recommended by Ford for the 1997 F-150 and Expedition models

Module (PCM) and the Idle Air Control (IAC) valve. The idle speed is not adjustable.

Fuel Filter

REMOVAL AND INSTALLATION

NOTE: On newer vehicles, especially the 1997 F-150 and Expedition vehicles, a fuel line disconnect tool such as Ford tool T93T-9550-AH is needed for this procedure.

1. Disconnect the negative battery cable and relieve the fuel system pressure.
2. Raise and support the vehicle safely.
3. Disconnect the fuel lines from the fuel filter. Have a drain pan handy to catch any residual fuel once the lines are separated. On newer models, disconnect the fuel lines from the filter as follows:
 - a. Disconnect the safety clip from the male hose.
 - b. Install and push the fuel line disconnect tool into the female fitting.
 - c. Separate the male and female fittings.
 - d. Inspect the fuel lines for any damage after the fuel is finished draining.
4. Remove the fuel filter from the bracket and the retainer, if equipped. Note the direction of the flow arrow so the replacement filter can be installed correctly.

To install:

5. Position the fuel filter into the mounting bracket with the flow arrow pointing in the correct direction.
6. Install the fuel lines to the fuel filter. On newer models, align and push the male tube into the female fitting until a click is heard. Pull on the fitting to ensure that it is fully engaged, then install the safety clip.
7. Lower the vehicle to the ground.

NOTE: When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles (16 km) or more to relearn the strategy.

8. Connect the negative battery cable.

Electric Fuel Pump

REMOVAL AND INSTALLATION

NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 10 miles (16 km) or more to relearn the strategy.

1997 F-150 and Expedition Models

1. Relieve the fuel system pressure.
2. Disconnect the negative battery cable.
3. Raise and support the vehicle safely on jackstands.
4. Remove the 6 fuel tank skid plate bolts, then lower the fuel tank skid plate.
5. Drain the fuel from the fuel tank.
6. Disconnect the fuel tank filler pipe hose from the fuel tank filler pipe.
7. Disconnect the fuel tank filler pipe vent hose from the fuel tank filler pipe.
8. Use Fuel Line Removal Tool T93T-9550-AH, or the equivalent, to disconnect the fuel lines from the fuel pump.
9. Detach the fuel tank front connections (EVAP hose and transducer electrical connector).
10. Detach the rear EVAP emissions hose.
11. Separate the fuel pump electrical connector from the fuel pump.
12. Drain the fuel from the fuel tank.
13. Position a hydraulic floor jack, such as the Hi-Lift Jack 014-00210, under the fuel tank.
14. Remove the 2 fuel tank support straps, then lower the fuel tank.
15. Remove the 6 fuel pump retaining bolts, then pull the fuel pump out of the fuel tank.

To install:

16. Clean the fuel pump mounting flange, then install the new fuel pump into the fuel tank. Tighten the fuel pump-to-fuel tank bolts to 67-92 inch lbs. (7.6-10.4 Nm).
17. Install the fuel tank. Make sure to tighten the fuel tank support strap bolts to 22-30 ft. lbs. (29-40 Nm).
18. Attach all hoses and electrical wiring harness connectors to the fuel tank and fuel pump.
19. Install the fuel tank skid plate and tighten the mounting bolts to 9-13 ft. lbs. (13-17 Nm).

20. Lower the vehicle and fill the fuel tank with fuel. Connect the negative battery cable.

21. Start the vehicle and check for fuel leaks.

Except 1997 F-150 and Expedition Models

1. Release the fuel system pressure. Disconnect the negative battery cable.
2. Raise and support the vehicle safely on jackstands.
3. Remove the fuel tank.
4. Remove the fuel pump in steel fuel tanks as follows:
 - a. Disconnect the wiring at the connector.
 - b. Remove all dirt from the area of the sender.
 - c. Disconnect the fuel lines.
 - d. Turn the locking ring counterclockwise to remove it.
5. To remove the fuel pump from a plastic fuel tank, perform the following:
 - a. Disconnect the wiring at the connector.
 - b. Remove all dirt from the area of the sender.
 - c. Disconnect the fuel lines.
 - d. Turn the locking ring counterclockwise to remove it.

6. Lift out the fuel pump and sending unit. Discard the gasket.

To install:

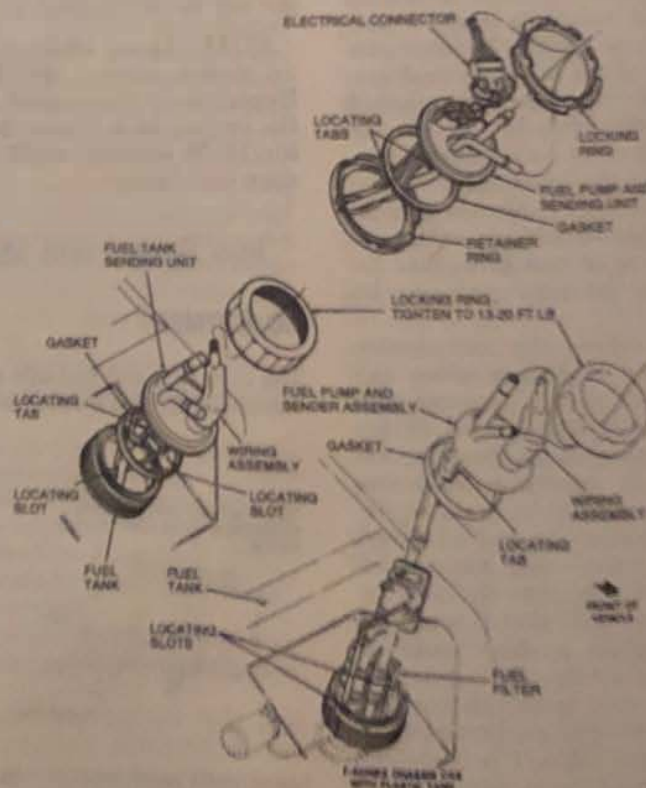
7. Place a new gasket in position in the groove in the tank.
8. Place the sending unit/fuel pump assembly in the tank, indexing the tabs with the slots in the tank. Make sure the gasket stays in place.
9. Hold the assembly in place and position the locking ring.
 - a. On steel tanks, turn the locking ring clockwise until the stop is against the retainer ring tab.
 - b. On plastic tanks, turn the retaining ring clockwise until hand-tight. Torque the ring to 40-55 ft. lbs. (54-75 Nm).
10. Make sure the gasket is still in place.
11. Connect the fuel lines and wiring.
12. Install the tank.

Fuel Injector

REMOVAL AND INSTALLATION

4.2L (VIN 2) Engine

1. Disconnect the negative battery cable.
2. Relieve the fuel system pressure.



Exploded view of the fuel tank mounted fuel pump — except 1997 F-150 and Expedition models

3. Remove the upper intake manifold.

4. Remove the fuel pressure regulator valve vacuum hose.

CAUTION

After disconnecting, plug the fuel lines to prevent leakage.

5. Remove the 2 fuel line connector retaining clips, then using Spring Lock Coupling Disconnect Tool D87L-9280-A or equivalent, disconnect the upper fuel line. Use Tool D87L-9280-B to disconnect the lower fuel line.

6. Remove and discard the 4 fuel line O-rings.

7. Detach the 6 fuel injector electrical wiring harness connectors.

8. Remove the 4 fuel injection supply manifold bolts, then lift the manifold off of the engine.

WARNING

The fuel injectors are deposit resistant. DO NOT clean the fuel injectors.

9. Remove the 6 fuel injectors from the supply manifold, then remove and inspect the 2 O-rings from each fuel injector. Replace the O-rings if any damage is evident.

To install:

10. Lubricate the new O-rings with engine oil before installation. Install the O-rings onto the fuel injectors, make sure that they are correctly seated in their grooves.

11. Install the fuel injectors onto the fuel injection supply manifold, then install the manifold and injectors onto the engine. Prior to installation, make certain that the fuel injector mounting bosses are clean. All of the fuel injectors should be corrected seated into their respective bosses before tightening the manifold retaining fasteners. Tighten the retaining fasteners to 71-102 inch lbs. (8-11 Nm).

12. Attach the electrical wiring harness connectors to the 6 fuel injectors.

13. Attach the 2 fuel lines and reconnect the vacuum hose to the pressure regulator valve.

14. Install the upper intake manifold, then connect the negative battery cable.

4.6L Engines (VIN W and VIN 6)

1. Disconnect the negative battery cable.

2. Relieve the fuel system pressure.

3. Partially drain the cooling system.

4. Remove the power steering reservoir bracket.

5. Remove the accelerator control splash shield.

6. Detach the fuel pressure regulator valve vacuum hose.

CAUTION

After disconnecting, plug the fuel lines to prevent leakage.

7. Remove the 2 fuel line connector retaining clips.

8. Remove the 2 fuel line connector retaining clips, then using Spring Lock Coupling Disconnect Tool D87L-9280-A or equivalent, disconnect the upper fuel line. Use Tool D87L-9280-B to disconnect the lower fuel line.

9. Remove and discard the 4 fuel line O-rings.

10. Detach the 8 fuel injector electrical wiring harness connectors.

11. Disconnect the heater water inlet tube hose, then remove the brake booster bracket and tube.

12. Remove the PCV hose.

13. Disconnect the Exhaust Gas Recirculation (EGR) components as follows:

a. Remove the EGR valve-to-exhaust manifold tube lower fitting.

b. Remove the EGR valve-to-exhaust manifold tube upper fitting and the EGR valve-to-exhaust manifold tube.

c. Detach the 2 Differential Pressure Feedback EGR (DPFE) transducer hoses.

d. Disconnect the EGR valve vacuum hose.

14. Disconnect the Vapor Management Valve (VMV) hose.

15. Remove the 4 fuel injection supply manifold bolts, then remove the fuel injectors from the supply manifold. Remove and discard the 2 O-rings from each fuel injector.

16. Remove the fuel injection supply manifold from the engine, if necessary.

To install:

17. Lubricate the new O-rings with engine oil before installation. Install the O-rings onto the fuel injectors, make sure that they are correctly seated in their grooves.

18. Position the fuel injection manifold on the engine, then install the fuel injectors onto the fuel injection supply manifold. Prior to installation, make certain that the fuel injector mounting bosses are clean. All of the fuel injectors should be corrected seated into their respective bosses before tightening the manifold re-

taining fasteners. Tighten the retaining fasteners to 71-102 inch lbs. (8-11 Nm).

19. Attach the EGR components as follows:

a. Attach the EGR valve vacuum hose.

b. Attach the 2 DPFE transducer hoses, then install the exhaust manifold tube to the EGR valve and the exhaust manifold tube upper fitting to the EGR valve.

c. Install the exhaust manifold tube lower fitting to the EGR valve.

20. Install the PCV hose.

21. Install the brake booster bracket and tube, then install the heater water inlet tube hose.

22. Attach the electrical wiring harness connectors to the 8 fuel injectors.

23. Attach the fuel lines. Make sure to install 4 new O-rings on the fuel lines and in the fuel line fittings.

24. Attach the fuel pressure regulator valve vacuum hose.

25. Install the accelerator control splash shield, then install the power steering reservoir bracket. Tighten the reservoir bracket mounting bolts to 49-67 ft. lbs. (68-92 Nm).

26. Fill the cooling system, then connect the negative battery cable.

4.9L (VIN Y and Z) Engine

1. Relieve the fuel system pressure.

2. Remove the upper intake manifold assembly.

3. Remove the fuel supply manifold.

4. Disconnect the wiring at each injector.

5. Pull upward on the injector body while gently rocking it from side-to-side.

6. Inspect the O-rings on the injector for any sign of leakage or damage. Replace any suspected O-rings.

7. Inspect the plastic cap at the top of each injector and replace it if any sign of deterioration is noticed.

To install:

8. Lubricate the O-rings with clean engine oil only!

9. Install the injectors by pushing them in with a gentle rocking motion.

10. Install the fuel supply manifold.

11. Connect the electrical wiring.

12. Install the upper intake manifold.

5.0L (VIN N) and 5.8L (VIN H and R) Engines

1. Relieve the fuel system pressure.

2. Disconnect the battery ground.

3. Remove the upper intake manifold.

4. Disconnect the wiring at the injectors.

5. Pull upward on the injector body while gently rocking it from side to side.

6. Inspect the O-rings on the injector for any sign of leakage or damage. Replace any suspected O-rings.

7. Inspect the plastic cap at the top of each injector and replace it if any sign of deterioration is noticed.

To install:

8. Lubricate the O-rings with clean engine oil.

9. Install the injectors by pushing them in with a gentle rocking motion.

10. Install the fuel supply manifold.

11. Connect the electrical wiring.

12. Install the upper intake manifold.

7.5L (VIN G) Engine

1. Relieve the fuel system pressure.

2. Disconnect the battery ground.

3. Remove the fuel supply manifold.

4. Disconnect the wiring at the injectors.

5. Pull upward on the injector body while gently rocking it from side to side.

6. Inspect the O-rings (2 per injector) on the injector for any sign of leakage or damage. Replace any suspected O-rings.

7. Inspect the plastic cap at the top of each injector and replace it if any sign of deterioration is noticed.

To install:

8. Lubricate the O-rings with clean engine oil only.

9. Install the injectors by pushing them in with a gentle rocking motion.

10. Install the fuel supply manifold.

11. Connect the electrical wiring.

DIESEL FUEL SYSTEM

Fuel System Service Precautions

Safety is the most important factor when performing not only fuel system maintenance but any type of maintenance. Failure to conduct maintenance and repairs in a safe manner may result in serious per-

sonal injury or death. Maintenance and testing of the vehicle's fuel system components can be accomplished safely and effectively by adhering to the following rules and guidelines.

- To avoid the possibility of fire and personal injury, always disconnect the negative battery cable unless the repair or test procedure requires that battery voltage be applied.

- Always relieve the fuel system pressure prior to disconnecting any fuel system component (injector, fuel rail, pressure regulator, etc.), fitting or fuel line connection. Exercise extreme caution whenever relieving fuel system pressure to avoid exposing skin, face and eyes to fuel spray. Please be advised that fuel under pressure may penetrate the skin or any part of the body that it contacts.

- Always place a shop towel or cloth around the fitting or connection prior to loosening to absorb any excess fuel due to spillage. Ensure that all fuel spillage (should it occur) is quickly removed from engine surfaces. Ensure that all fuel soaked cloths or towels are deposited into a suitable waste container.

- Always keep a dry chemical (Class B) fire extinguisher near the work area.

- Do not allow fuel spray or fuel vapors to come into contact with a spark or open flame.

- Always use a backup wrench when loosening and tightening fuel line connection fittings. This will prevent unnecessary stress and torsion to fuel line piping. Always follow the proper torque specifications.

- Always replace worn fuel fitting O-rings with new. Do not substitute fuel hose or equivalent where fuel pipe is installed.

Fuel System

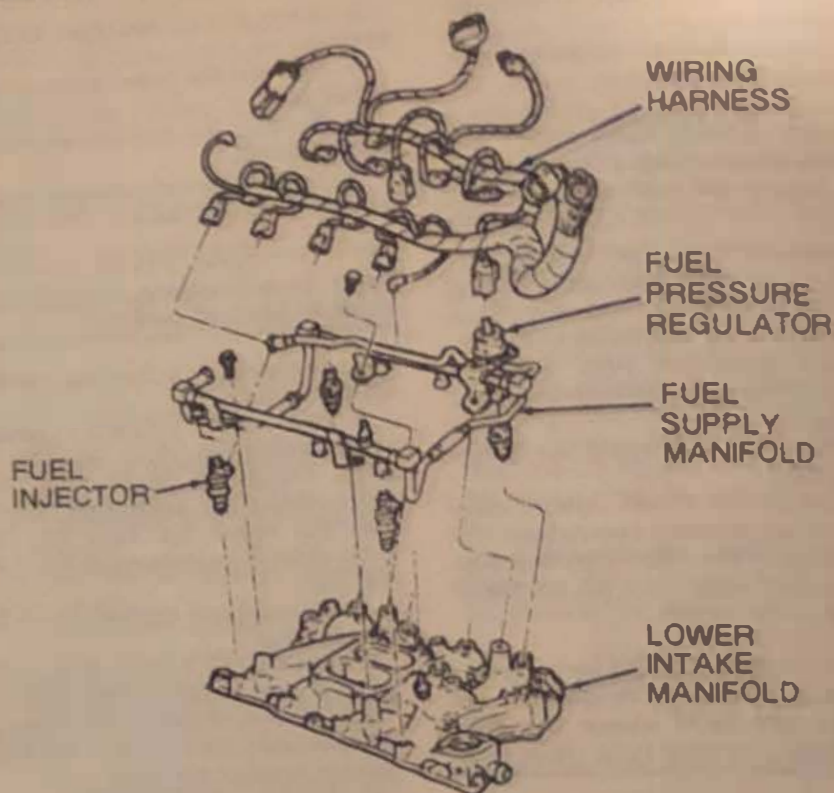
RELIEVING PRESSURE

CAUTION

Before removing the fuel tank filler cap, turn the fuel tank filler cap $\frac{1}{4}$ to $\frac{1}{2}$ turn counterclockwise and wait for the tank pressure to be relieved. Personal injury may result if the fuel tank filler cap is removed without the pressure fully relieved.

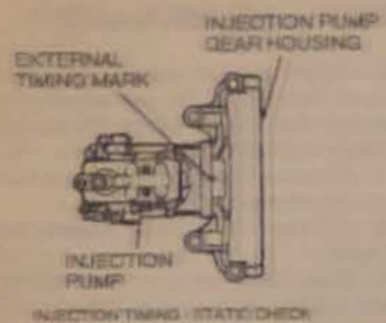
1. Remove the fuel tank filler cap to relieve any pressure in the fuel tank.

2. When servicing the fuel lines, loosen the fuel fitting to allow any

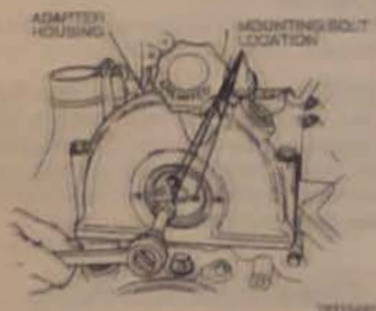


Fuel injector removal — 7.5L (VIN G) engine

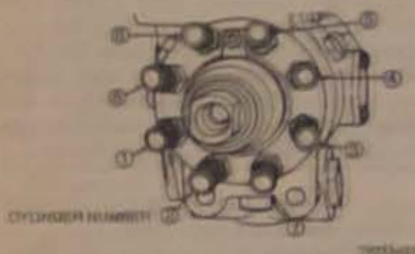
7W11101A



Injection pump timing marks — 7.3L (VIN C, F, K, and M) Diesel engine



Injection pump drive gear attaching bolt removed — 7.3L (VIN C, F, K, and M) Diesel engine



Injection pump cylinder numbering sequence — 7.3L (VIN C, F, K, and M) Diesel engine

9. Remove and cap the injection pump inlet elbow and the injection pump fitting adapter.

10. Remove the fuel return line on injection pump, rotate out of the way. And cap all fittings.

NOTE: It is not necessary to remove injection lines from injection pump. If lines are to be removed, loosen injection line fittings at injection pump before removing it from engine.

11. Remove the fuel injection lines from the nozzles and cap lines and nozzles.

12. Remove the 3 nuts attaching the injection pump to injection pump adapter using Tool T83T-9000-B.

13. If the injection pump is to be replaced, loosen the injection line retaining clips and the injection nozzle fuel lines with Tool T83T-9396-A and cap all fittings at this time with protective cap set T83T-9395-A or equivalent. Do not install the injection nozzle fuel lines until the new pump is installed in the engine.

14. Lift the Injection pump, with the nozzle lines attached, up and out of the engine compartment.

WARNING

Do not carry injection pump by injection nozzle fuel lines as this could cause lines to bend or crimp.

To install:

15. Install a new O-ring on the drive gear end of the injection pump.

16. Move the injection pump down and into position.

17. Position the alignment dowel on injection pump into the alignment hole on drive gear.

18. Install the bolts attaching the injection pump to drive gear and tighten.

19. Install the nuts attaching injection pump to adapter. Align scribe lines on the injection pump flange and the injection pump adapter and tighten to 14 ft. lbs. (20 Nm).

20. If the injection nozzle fuel lines were removed from the injection pump install at this time.

21. Remove the caps from nozzles and the fuel lines and install the fuel line nuts on the nozzles and tighten to 22 ft. lbs. (30 Nm).

22. Connect the fuel return line to injection pump and tighten the nuts.

23. Install the injection pump fitting adapter with a new O-ring.

24. Clean the old sealant from the injection pump elbow threads, using clean solvent, and dry thoroughly. Apply a light coating of pipe sealant to the elbow threads.

25. Install the elbow in the injection pump adapter and tighten to a minimum of 8 ft. lbs. (8 Nm). Then tighten further, if necessary, to align the elbow with the injection pump fuel inlet line, but do not exceed 360 degrees of rotation or 10 ft. lbs. (14 Nm).

26. Remove the caps and reconnect the fuel filter-to-injection pump fuel line.

27. Install the accelerator cable bracket to the intake manifold.

28. Remove the rags from the intake manifold and install the air cleaner.

29. Connect the accelerator and speed control cable, if equipped, to throttle lever.

30. Install the electrical connectors on injection pump.

31. Clean the injection pump adapter and oil filler neck sealing surfaces.

32. Apply a 1/8 in. (3mm) bead of RTV sealant on the adapter housing.

33. Install the oil filler neck and tighten the bolts.

34. Connect the battery ground cables to both batteries.

35. Run the engine and check for fuel leaks.

36. If necessary, purge high pressure fuel lines of air by loosening connector 1/4 to 1 turn and cranking engine until solid fuel, free from bubbles flows from connection.

CAUTION

Keep eyes and hands away from nozzle spray. Fuel spraying from the nozzle under high pressure can penetrate the skin.

37. Check and adjust injection pump timing.

Diesel Fuel Injector

REMOVAL AND INSTALLATION

NOTE: Before removing the nozzle assemblies, clean the exterior of each nozzle assembly and the surrounding area with clean fuel oil or solvent to prevent entry of dirt into the engine when nozzle assemblies are removed. Also, clean the fuel inlet and fuel leak-off piping connections. Blow dry with compressed air.

1. Remove the fuel line retaining clamp(s) from the nozzle lines that are to be removed.

2. Disconnect the nozzle fuel inlet (high pressure) and fuel leak-off lines from each nozzle assembly and position out of the way. Cover the open ends of the fuel inlet and outlet or nozzles with protective caps, to prevent dirt from entering.

3. Remove the injection nozzles by turning them counterclockwise. Pull the nozzle assembly with the copper washer attached from the engine. Cover the nozzle fuel opening and

spray tip, with plastic caps, to prevent the entry of dirt.

NOTE: Remove the copper injector nozzle gasket from the nozzle bore with special tool, T71P-19703-C, or equivalent, whenever the gasket does not come out with the nozzle.

4. Place the nozzle assemblies in a fabricated holder as they are removed from the heads. The holder should be marked with numbers corresponding to the cylinder numbering of the engine. This will allow for reinstallation of the nozzle in the same ports from which they were removed.

To install:

5. Thoroughly clean the nozzle bore in cylinder head before reinserting the nozzle assembly with nozzle seat cleaner, special tool T83T-9527-A or equivalent. Make certain that no small particles of metal or carbon remain on the seating surface. Blow out the particles with compressed air.

6. Remove the protective cap and install a new copper gasket on the nozzle assembly, with a small dab of grease.

NOTE: Anti-seize compound or equivalent should be used on nozzle threads to aid in installation and future removal.

7. Install the nozzle assembly into the cylinder head nozzle bore.

8. Tighten the nozzle assembly to 33 ft. lbs. (45 Nm).

9. Remove the protective caps from nozzle assemblies and fuel lines.

10. Install the leak-off tees to the nozzle assemblies.

NOTE: Install 3 new O-ring seals for each fuel return tee.

11. Connect the high pressure fuel line and tighten, using a flare nut wrench.

12. Install the fuel line retainer clamps.

13. Start the engine and check for leaks.

EMISSION CONTROLS

Emission Warning Lamps

RESETTING

All gasoline engine equipped light vehicles built for sale outside of California employ this device.

The EMW consists of an instrument panel mounted amber light imprinted with the word EGR, EMISS, or EMISSIONS. The light is connected to a sensor module located under the instrument panel. The purpose is the warn the driver that the 60,000 mile emission system maintenance is required on the vehicle. Specific emission system maintenance requirements are listed in the vehicle's owner's manual maintenance schedule.

1. Turn the key to the OFF position.

2. Lightly push a Phillips screwdriver through the 0.2 in. (5mm) diameter hole labeled RESET, and lightly press down and hold it.

3. While maintaining pressure with the screwdriver, turn the key to the RUN position. The EMW lamp will light and stay lit as long as pressure is kept on the screwdriver. Hold the screwdriver down for about 5 seconds.

4. Remove the screwdriver. The lamp should go out within 2-5 seconds. If not, repeat Steps 1-3.

5. Turn the key OFF.

6. Turn the key to the RUN position. The lamp will light for 2-5 seconds and then go out. If not, repeat the reset procedure.

NOTE: If the light comes ON between 15,000 and 45,000 miles or between 75,000 and 105,000 miles, replace the 1,000 hour pre-timed module.

GASOLINE ENGINE MECHANICAL

NOTE: Disconnecting the negative battery cable on some vehicles may interfere with the functions of the on board computer systems and may require the

computer to undergo a relearning process, once the negative battery cable is reconnected.

Engine Assembly

REMOVAL AND INSTALLATION

NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 10 miles (16 km) or more to relearn the strategy.

4.2L (VIN 2) Engine

NOTE: To perform the following procedure an engine lifting bracket, such as Ford Tool 014-00730, and an engine hoist or lift are needed.

1. On vehicles equipped with Air Conditioning (A/C), have the A/C system discharged by a qualified mechanic using approved recovery/recycling equipment.

2. Disconnect the negative battery cable.

3. Remove the hood from the vehicle.

4. Drain the cooling system.

5. Relieve the fuel system pressure.

6. Remove the front upper air deflector.

7. Remove the engine air cleaner outlet tube.

8. Remove the radiator, fan blade assembly and fan shroud.

9. Remove the accelerator control splash shield.

10. Disconnect the accelerator cable and, if equipped, the speed control actuator cable. Position both cables aside.

11. Disconnect the Vapor Management Valve (VMV) hose.

12. Detach the manifold vacuum connection.

13. Detach the following vacuum connections from the following intake manifold components:

a. Intake Manifold Runner Control (IMRC).

b. Fuel pressure regulator.

c. IMRC solenoid.

d. Engine Vacuum Regulator (EVR).

e. Vacuum reservoir.

14. Detach the EGR valve vacuum connection.

15. Position the power steering reservoir and, on vehicles equipped with A/C, the A/C lines aside.

16. Position the power steering pump aside.
17. Remove the alternator electrical wiring harness connectors.
18. Remove the fuel injector and related wiring.
19. Label, then remove the spark plug wires.
20. Disconnect the 2 heater hoses.
21. Detach the brake booster vacuum hose.
22. Disconnect the Differential Pressure Feedback EGR (DPFE) transducer hose.
23. Remove the breather from the rocker arm cover.
24. Remove the upper intake manifold. Remove and discard the intake manifold upper gasket. Plug the open intake manifold holes with clean shop rags so that nothing (i.e. loose nuts or bolts) can fall down them.
25. Disconnect the fuel lines from the fuel injection supply manifold, then remove the fuel injection supply manifold and injectors.
26. Raise and safely support the vehicle on jackstands.
27. If equipped, detach the block heater cable.
28. Remove the 4 catalytic converter-to-exhaust manifold nuts (2 on each side).
29. Remove the starter motor.
30. Remove the transmission assembly.
31. If equipped, remove the clutch assembly.
32. Remove the right-hand and left-hand engine mount through-bolts.
33. Lower the vehicle.
34. Install the engine lifting bracket 014-00073, or equivalent, as follows:
 - a. Install a link in each engine lifting eye.
 - b. Connect each end of the lifting bracket to a link.
 - c. Connect the chain to an engine lift/hoist. Use the lift/hoist to raise the engine out of the vehicle.
35. Mount the engine on an engine work stand for disassembly.
- To install:**
 36. Install the engine lifting bracket 014-00073, or equivalent, as follows:
 - a. Install a link in each engine lifting eye.
 - b. Connect each end of the lifting bracket to a link.
 - c. Connect the chain to an engine lift/hoist. Use the lift/hoist to raise the engine and position it in the vehicle.
 37. Remove the lifting bracket and engine hoist.

38. Raise and support the vehicle safely on jackstands.
 39. Install the right-hand and left-hand engine mount through-bolts to 51-67 ft. lbs. (68-92 Nm).
 40. If equipped, install the clutch assembly.
 41. Install the transmission assembly into the vehicle.
 42. Install the starter motor.
 43. Install the catalytic converter to the exhaust manifolds. Tighten the attaching nuts to 26-34 ft. lbs. (34-46 Nm).
 44. Connect the block heater cable, if equipped.
 45. Attach the alternator electrical wiring harness connectors.
 46. Install the fuel injectors and fuel injection supply manifold onto the engine.
 47. Install the upper intake manifold. Make sure to use a new gasket.
 48. Install the fuel injector and related wiring.
 49. Install the power steering pump in place. Tighten the mounting bolts to 17-20 ft. lbs. (22-28 Nm).
- NOTE: When installing the A/C lines, make sure that the O-rings are properly installed.**
50. If equipped, install the A/C compressor manifold. Tighten the retaining bolt to 14-18 ft. lbs. (18-24 Nm).
 51. Install the power steering reservoir. Tighten the 3 mounting bolts to 80-107 inch lbs. (9-12 Nm).
 52. Connect the VMV hose. Attach the vacuum connectors to the following components:
 - a. Intake Manifold Runner Control (IMRC).
 - b. Fuel pressure regulator.
 - c. IMRC solenoid.
 - d. Engine Vacuum Regulator (EVR).
 - e. Vacuum reservoir.
 53. Attach the EGR valve vacuum connector.
 54. Connect the brake booster vacuum hose.
 55. Connect the 2 DPFE transducer hoses.
 56. Attach the intake manifold vacuum hose.
 57. Position the accelerator cable end, if equipped, the speed control actuator cable, then install the bracket bolts. Tighten the accelerator cable bracket bolt to 19-25 inch lbs. (2.1-2.9 Nm) and the speed control actuator cable bracket bolt to 53-72 inch lbs. (5.9-8.1 Nm). Connect the cable ends to the throttle body.
 58. Install the accelerator control splash shield.
 59. Install the radiator, fan blade assembly and fan shroud.

60. Install the engine air cleaner outlet tube.
61. Install the front air deflector.
62. Fill the cooling system.
63. Install the hood, then connect the negative battery cable.
64. If applicable, have the A/C system evacuated and recharged by a qualified mechanic utilizing a refrigerant recovery/recycling machine.

4.6L Engines (VIN W and VIN 6)

NOTE: To perform the following procedure an engine lifting bracket, such as Ford Tool 014-000730, and an engine hoist or lift are needed.

1. On vehicles equipped with Air Conditioning (A/C), have the A/C system discharged by a qualified mechanic using approved recovery/recycling equipment.
2. Disconnect the negative battery cable.
3. Remove the hood from the vehicle.
4. Remove the radiator.
5. Remove the upper intake manifold.
6. Remove the bulkhead connector cover.
7. Separate the engine bulkhead connector.
8. Disconnect the power steering oil reservoir and bracket.
9. Detach the EGR connections:
 - 2 DPFE transducer hoses (B)
 - EGR valve-to-exhaust manifold tube upper fitting (A).
 - EGR valve-to-exhaust manifold tube lower fitting (C).
10. Slide the hose clamp back, then disconnect the heater water hose.
11. Detach the following electrical wiring harness connectors from each coil assembly:
 - Ignition coil connector
 - Camshaft Position (CMP) sensor connector
 - Radio capacitor connector
12. Remove the ignition coils and brackets.
13. Raise and safely support the vehicle on jackstands.
14. Remove the starter motor.
15. Remove the accessory drive belt, if not already performed.
16. Remove the A/C compressor.
17. On vehicles equipped with automatic transmissions, remove the transmission cooler hoses from the block mounted clip. Also remove the transmission inspection cover, torque converter bolts and transmission-to-engine block bolts.
18. On vehicles equipped with manual transmissions, remove the clutch assembly.

19. Remove the 2 top power steering pump bolts. Remove the 2 lower power steering pump bolts, then position the pump aside.

20. Remove the right-hand exhaust manifold-to-3 way catalytic converter nuts. Remove the right-hand exhaust manifold studs.

21. Remove the left-hand exhaust manifold-to-catalytic converter nuts and position the Y-pipe aside.

22. Lower the vehicle and support the transmission with a hydraulic floor jack.

23. Install the engine lift bracket, or equivalent and the engine floor crane/hoist to the engine block.

24. Lift the engine out of the vehicle and mount on an engine work stand.

To install:

25. On vehicles equipped with manual transmissions, install the clutch assembly.

26. Use the floor crane and lifting bracket to install the engine in the vehicle.

NOTE: Align the engine-to-transmission dowel pins before installing the engine-to-transmission bolts.

27. On vehicles equipped with automatic transmissions, install the transmission-to-engine block bolts, the converter bolts and the transmission inspection cover.

28. Raise and support the vehicle safely on jackstands.

29. Install the right-hand exhaust manifold studs and exhaust manifold-to-catalytic converter nuts. Tighten the nuts to 25-34 ft. lbs. (34-46 Nm).

30. Install the left-hand manifold-to-catalytic converter nuts. Tighten the nuts also to 25-34 ft. lbs. (34-46 Nm).

31. Install the 2 lower, then the 2 upper power steering bolts. Tighten all 4 bolts to 15-20 ft. lbs. (20-30 Nm).

32. Install the Crankshaft Position (CKP) sensor. Tighten the retaining bolts to 72-107 ft. lbs. (8-12 Nm). Attach the CKP sensor electrical wiring harness connector.

33. Install the transmission fluid cooler hoses into the cylinder block mounted clip.

34. Install the A/C compressor.

35. Install the accessory drive belt.

36. Install the starter motor.

37. Install the ignition coils and mounting brackets. Tighten the bracket nuts to 15-23 ft. lbs. (20-30 Nm).

38. Attach the following electrical connections:

- Right-hand and left-hand ignition coil connectors
- Radio capacitor connector
- Camshaft Position (CMP) sensor connector

39. Position the rear heater water hose and compress, then slide the hose clamp into position.

40. Install the following EGR connections:

- EGR valve-to-exhaust manifold tube upper fitting—26-33 ft. lbs. (35-45 Nm)
- EGR valve-to-exhaust manifold tube lower fitting—26-33 ft. lbs. (35-45 Nm)
- The 2 DPFE transducer hoses

41. Install the power steering oil reservoir bracket. Tighten the lower 2 bolts to 26-33 ft. lbs. (35-45 Nm) and the upper bolts to 71-107 inch lbs. (8-12 Nm).

42. Attach the engine bulkhead connector.

43. Install the bulkhead connector cover.

44. Install the intake manifold.

45. Install the radiator.

46. Install the hood.

47. Fill the cooling system and fill the engine and transmission with the proper amount and type of fluids.

48. Connect the negative battery cable, start the engine and check for leaks and proper operation.

4.9L (VIN Y and Z) Engine

1. Disconnect the negative battery cable(s) before beginning any work. Label all disconnected hoses, vacuum lines and wires.

2. Drain the cooling system and the crankcase.

3. Remove the hood.

4. Remove the throttle body inlet tubes.

5. Disconnect the positive battery cable.

6. Discharge the air conditioning system.

7. Disconnect the refrigerant lines at the compressor. Cap all openings at once.

8. Remove the compressor.

9. Disconnect the refrigerant lines at the condenser. Cap all openings at once.

10. Remove the condenser.

11. Disconnect the heater hose from the water pump and coolant outlet housing.

12. Disconnect the flexible fuel line from the fuel pump.

13. Remove the radiator.

14. Remove the fan, water pump pulley, and fan belt.

15. Disconnect the accelerator cable.

16. Disconnect the brake booster vacuum hose at the intake manifold.

17. If equipped with automatic transmission, disconnect the transmission kickdown rod at the bell crank assembly.

18. Disconnect the exhaust pipe from the exhaust manifold.

19. Disconnect the Electronic Engine Control (EEC) harness from all the sensors.

20. Disconnect the body ground strap and the battery ground cable from the engine.

21. Disconnect the engine wiring harness at the ignition coil, the coolant temperature sending unit, and the oil pressure sensing unit. Position the wiring harness out of the way.

22. Remove the alternator mounting bolts and position the alternator out of the way.

23. Remove the power steering pump from the mounting brackets and move it to one side, leaving the lines attached.

24. Raise and support the vehicle on jackstands.

25. Remove the starter.

26. Remove the automatic transmission filler tube bracket, if equipped.

27. Remove the rear engine plate upper right bolt.

28. On manual transmission equipped vehicles:

a. Remove the flywheel housing lower attaching bolts.

b. Disconnect the clutch return spring.

29. On automatic transmission equipped vehicles:

a. Remove the converter housing access cover assembly.

b. Remove the flywheel-to-converter attaching nuts.

c. Secure the converter in the housing.

d. Remove the transmission oil cooler lines from the retaining clip at the engine.

e. Remove the lower converter housing-to-engine attaching bolts.

30. Remove the nut from each of the 2 front engine mounts.

31. Lower the vehicle and position a jack under the transmission and support it.

32. Remove the remaining bell housing-to-engine attaching bolts.

33. Attach an engine lifting device and raise the engine slightly and carefully pull it from the transmission. Lift the engine out of the vehicle.

To install:

34. Remove the engine mount brackets from the frame. Attach them to the engine mounts, making the nuts just tight enough to hold the brackets securely to the mounts.

35. Place a new gasket on the muffler inlet pipe.

36. Carefully lower the engine into the vehicle. Make sure the dowels in the engine block engage the holes in the bell housing and the mount bracket holes align with the frame holes.

37. On manual transmission equipped vehicles, start the transmission input shaft into the clutch disc. It may be necessary to adjust the position of the engine or transmission in order for the input shaft to enter the clutch disc. If necessary, turn the crankshaft until the input shaft splines mesh with the clutch disc splines.

38. On automatic transmission equipped vehicles, start the converter pilot into the crankshaft. Secure the converter in the housing.

39. Install the bolts securing the mount brackets to the frame.

40. Install the bell housing upper attaching bolts. Torque the bolts to 50 ft. lbs. (68 Nm).

41. Remove the jack supporting the transmission.

42. Remove the lifting device.

43. Install the engine mount nuts and tighten them to 70 ft. lbs. (95 Nm). Tighten the bracket-to-frame bolts to 70 ft. lbs. (95 Nm).

44. Install the automatic transmission oil cooler lines bracket, if equipped.

45. Install the remaining bell housing attaching bolts. Torque them to 50 ft. lbs. (68 Nm).

46. Connect the clutch return spring, if equipped.

47. Install the starter and connect the starter cable.

48. Attach the automatic transmission fluid filler tube bracket, if equipped.

49. If equipped with automatic transmissions, install the transmission oil cooler lines in the bracket at the cylinder block.

50. Connect the exhaust pipe to the exhaust manifold. Tighten the nuts to 25-35 ft. lbs. (34-48 Nm).

51. Connect the engine ground strap and negative battery cable.

52. On a vehicle with an automatic transmission, connect the kickdown rod to the bell crank assembly on the intake manifold.

53. Connect the accelerator linkage.

54. Connect the brake booster vacuum line to the intake manifold.

55. Connect the coil primary wire, oil pressure and coolant temperature sending unit wires, fuel line, heater hoses, and the battery positive cable.

56. Connect the EEC sensors.

57. Install the alternator on its mounting bracket.

58. Install the power steering pump on its bracket.

59. Install the water pump pulley, spacer, fan, and fan belt. Adjust the belt tension.

60. Install the air conditioning compressor. Connect the refrigerant lines.

61. Install the radiator.

62. Install the condenser and connect the refrigerant lines.

63. Charge the refrigerant system.

64. Connect the upper and lower radiator hoses to the radiator and engine.

65. Connect the automatic transmission oil cooler lines, if equipped.

66. Install and adjust the hood.

67. Fill the cooling system.

68. Fill the crankcase.

69. Start the engine and check for leaks.

70. Bleed the cooling system.

71. Adjust the clutch pedal free-play or the automatic transmission control linkage.

72. Install the air cleaner.

5.0L (VIN N) and 5.8L (VIN H and R) Engines

1. Remove the hood.

2. Drain the cooling system and crankcase.

3. Disconnect the battery and alternator cables.

4. Remove the air intake hoses, PCV tube and carbon canister hose.

5. Disconnect the upper and lower radiator hoses.

6. Discharge the air conditioning system.

7. Disconnect the refrigerant lines at the compressor. Cap all openings immediately.

8. If equipped, disconnect the automatic transmission oil cooler lines.

9. Remove the fan shroud and lay it over the fan.

10. Remove the radiator and fan, shroud, fan, spacer, pulley and belt.

11. Remove the alternator pivot and adjusting bolts. Remove the alternator.

12. Disconnect the oil pressure sending unit lead from the sending unit.

13. Disconnect the fuel tank-to-pump fuel line at the fuel pump and plug the line.

14. If equipped, disconnect the chassis fuel line at the fuel rails.

15. Disconnect the accelerator linkage and speed control linkage at the throttle body.

16. Disconnect the automatic transmission kick-down rod and remove the return spring, if equipped.

17. Disconnect the power brake booster vacuum hose.

18. Disconnect the throttle bracket from the upper intake manifold and swing it out of the way with the cables still attached.

19. Disconnect the heater hoses from the water pump and tee.

20. Disconnect the temperature sending unit wire from the sending unit.

21. Remove the upper bell housing-to-engine attaching bolts.

22. Remove the wiring harness from the left rocker arm cover and position the wires out of the way.

23. Disconnect the ground strap from the cylinder block.

24. Disconnect the air conditioning compressor clutch wire.

25. Raise the front of the vehicle and disconnect the starter cable from the starter.

26. Remove the starter.

27. Disconnect the exhaust pipe from the exhaust manifolds.

28. Disconnect the engine mounts from the brackets on the frame.

29. If equipped with automatic transmissions, remove the converter inspection plate and remove the torque converter-to-flywheel attaching bolts.

30. Remove the remaining bell housing-to-engine attaching bolts.

31. Lower the vehicle and support the transmission with a jack.

32. Install an engine lifting device.

33. Raise the engine slightly and carefully pull it out of the transmission. Lift the engine out of the engine compartment.

To install:

34. Remove the engine mount brackets from the frame and attach them to the engine mounts. Tighten the mount-to-bracket nuts just enough to hold them securely.

35. Lower the engine carefully into the transmission. Make sure the dowel in the engine block engage the holes in the bell housing through the rear cover plate. If the engine hangs up after the transmission input shaft enters the clutch disc (manual transmission only), turn the crankshaft with the transmission in gear until the input shaft splines mesh with the clutch disc splines.

radiator hoses, and, if equipped
automatic transmission oil
lines.

• η_{sp} in.: 85–120 fl. lbs. (110–130 Nm)

10. Discharge the air conditioning system.
11. Disconnect the refrigerant lines at the compressor. Cap the openings at once!
12. Disconnect the refrigerant lines at the condenser. Cap the openings at once!
13. Remove the condenser.
14. Remove the fan shroud from the radiator and position it up, over the fan.
15. Remove the radiator.
16. Remove the fan shroud.
17. Remove the fan, belts and pulley from the water pump.
18. Remove the compressor.

41. Lower the engine slowly to the ground.

42. Slide the engine rearward to engage it with the transmission and slowly lower it onto the supports.

43. Tighten the engine support nuts to 74 ft. lbs. (100 Nm). Tighten the bracket bolts to 70 ft. lbs. (95 Nm).

44. Remove the engine lifting device.

45. Install the converter housing-to-engine block upper and left side attaching bolts. Torque the bolts to 50 ft. lbs. (68 Nm).

46. Install the coil and bracket assembly on the intake manifold.

47. Remove the jack from under the transmission.

48. Lower the vehicle.

49. Install the upper converter housing-to-engine attaching bolts. Torque the bolts to 50 ft. lbs. (68 Nm).

50. Install the flywheel-to-converter attaching nuts. Torque the nuts to 34 ft. lbs. (47 Nm).

51. Install the access cover on the converter housing. Torque the bolts to 60-90 inch lbs. (6.7-10 Nm).

52. Install the starter.

53. Connect the starter cable.

54. Raise the vehicle and connect the exhaust pipes at the exhaust manifolds.

55. Connect the engine wiring harness at the connector on the fire wall.

56. Connect the primary wire at the coil.

57. Connect the accelerator rod and the transmission kickdown rod.

58. Connect the speed control cable.

59. Connect all vacuum lines at the rear of the intake manifold.

60. Install the transmission fluid filler tube attaching bolt from the right side valve cover and position the tube out of the way.

61. Connect the heater hoses.

62. Connect the ground cable at the right front corner of the engine.

63. Install the alternator and drive belts.

64. Connect the oil pressure sending unit wire at the sending unit.

65. Connect the fuel pump inlet line at the pump and plug the line.

66. Install the power steering pump and belt.

67. Install air conditioning compressor. Connect the refrigerant lines.

68. Install the fan, belts and pulley on the water pump.

69. Position the fan shroud over the fan.

70. Install the radiator.

71. Attach the fan shroud.

72. Install the condenser.

73. Connect the refrigerant lines at the condenser.

74. Charge the air conditioning system.

75. Connect the oil cooler lines at the oil filter adapter.

76. Connect the transmission oil cooler lines at the radiator.

77. Connect the upper and lower radiator hoses.

78. Connect the canister hose.

79. Connect the crankcase ventilation hose.

80. Connect the negative battery cable from the block.

81. Fill the cooling system.

82. Install the air cleaner assembly.

83. Install the hood.

If the torque for a particular fastener was not mentioned above, use the following torque values as a guide:

- 1/4 in.-20: 6-9 ft. lbs. (8-12 Nm)
- 1/2 in.-18: 12-18 ft. lbs. (16-25 Nm)
- 3/8 in.-16: 22-32 ft. lbs. (30-44 Nm)
- 7/16 in.-14: 45-57 ft. lbs. (61-78 Nm)
- 1/2 in.-13: 55-80 ft. lbs. (75-109 Nm)
- 9/16 in.: 85-120 ft. lbs. (116-163 Nm)

Engine Mounts

REMOVAL AND INSTALLATION

Front Mounts

1997 F-150 and Expedition Models

NOTE: If both engine mounts are to be replaced, remove and install one engine mount at a time. This will allow the engine to remain correctly positioned for easier installation.

1. Remove the engine cooling fan and fan shroud.

2. Raise and safely support the vehicle on jackstands.

3. Remove the mount-to-frame mount bolt on the first engine mount to be removed.

a. Loosen the other engine mount's frame mount bolt.

b. Lift the engine slightly with a hydraulic floor crane/hoist, or equivalent.

4. Remove the 3 engine mount-to-cylinder block bolts, then remove the engine mount.

To install:

5. Situate the new engine mount in position on the engine block, then install the engine mount-to-engine block bolts. Tighten the bolts to 39-53 ft. lbs. (53-72 Nm).

6. Slowly lower the engine onto the engine mounts.

7. If the other engine mount is also going to be removed, leave that mount's through-bolt loose for now, otherwise tighten it to 50-68 ft. lbs. (68-92 Nm).

8. Install the through-bolt in the new engine mount. If the other engine mount is going to be removed, leave the new mount's through-bolt also loose for now, otherwise tighten it to 50-68 ft. lbs. (68-92 Nm).

9. If necessary, repeat the process for the other engine mount. Once both mounts have been installed, make sure that the engine mount through-bolts are tightened to 50-68 ft. lbs. (68-92 Nm).

10. Lower the vehicle to the ground.

11. Install the fan shroud and engine cooling fan.

Except 1997 F-150 and Expedition Models

1. Remove the fan shroud attaching screws.

2. Support the engine using a wood block and a jack placed under the oil pan.

3. Remove the nuts and washers attaching the mounts to the engine bracket. Lift the engine enough to disengage the mount upper stud from the crossmember engine bracket.

4. Remove the bolt attaching the fuel pump shield to the left engine bracket, if necessary.

5. Remove the mount-to-crossmember attaching nut and washer assembly. Remove the engine mount.

To install:

6. Install the engine mount to the crossmember.

7. Install the bolt attaching the fuel pump shield to the left bracket, if necessary.

8. Lower the engine until the mount stud engages in the slot/hole of the engine bracket. Install the attaching nuts.

9. Remove the jack and wood block from the engine oil pan. Install the fan shroud attaching screws.

Rear Mount

1. Place a block of wood and a jack under the transmission.

2. Remove the 2 nuts attaching the mount to the crossmember. Raise the transmission enough to lift the mount from the crossmember.

3. Remove the bolts and nuts attaching the crossmember to the frame side rails and remove the crossmember.

4. If equipped, remove the fasteners attaching the exhaust hanger to the rear engine mount.

5. Remove the 2 bolts attaching the mount to the transmission and remove the mount and retainer assembly.

To install:

6. Position the mount and retainer assembly to the transmission and install the 2 attaching bolts.

7. If equipped, install the fasteners attaching the exhaust hanger to the mount.

8. Install the crossmember to the frame side rails with the attaching nuts and bolts.

9. Lower the transmission and install the mount crossmember attaching nuts. Remove the jack and wood block.

Cylinder Head

REMOVAL AND INSTALLATION

4.2L (VIN 2) Engine

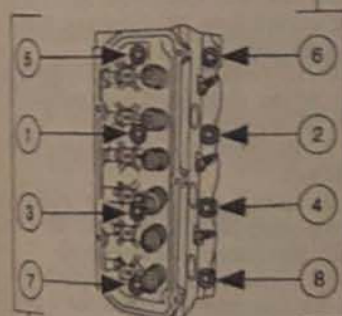
1. On vehicles equipped with Air Conditioning (A/C), have the A/C system discharged by a qualified mechanic using an approved refrigerant recovery/recycling machine.

2. Disconnect the negative battery cable.

3. Drain the cooling system.

(C) 175 - 185°

20 - 30 Nm
(15 - 32 Lb - Ft)



40 - 50 Nm
(30 - 36 Lb - Ft)



After torquing the cylinder head bolts one at a time in the sequence shown here, then tighten in a second 175-185 degrees — 4.2L (VIN 2) engine

4. Remove the upper intake manifold and related components.

5. Remove the lower intake manifold and related components.

6. Remove the rocker arm covers.

7. Remove the exhaust manifold.

8. If removing the left-hand cylinder head, perform the following:

a. Position the power steering pump reservoir aside and remove the A/C compressor.

b. Remove and support the A/C compressor bracket and power steering pump aside.

9. If removing the right-hand cylinder head, perform the following:

a. Remove the alternator.

b. Remove the idler pulley.

c. Remove the alternator bracket.

NOTE: If the cylinder head components, such as rocker arms, valve springs, etc., are to be reinstalled, they must be installed in the same position. Mark the components for original location.

10. Remove the 6 rocker arms by removing the retaining bolts.

11. Pull the pushrods out of the engine. Once again, make sure to label or mark the components removed for reinstallation in their original location.

12. Remove and discard the 8 cylinder head mounting bolts. New bolts are a must for installation.

13. Lift the cylinder head off of the engine block. Remove the cylinder head gasket and discard.

To install:

14. Clean and inspect the cylinder head for flatness.

15. Install a new cylinder head gasket on the cylinder block with the small hole to the front of the engine, then install the cylinder head.

WARNING

Always use new cylinder head bolts for installation.

16. Lubricate the cylinder head bolts with clean engine oil prior to installation.

NOTE: Make sure to tighten the cylinder head bolts in three (3) steps.

17. Install the new cylinder head bolts. Tighten the cylinder head bolts in the sequence shown and in three steps to the following values:

- Step 1 — 14 ft. lbs. (20 Nm)
- Step 2 — 29 ft. lbs. (40 Nm)
- Step 3 — 36 ft. lbs. (50 Nm)

WARNING

Do not loosen all of the cylinder head bolts at one time. Each cylinder head bolt must be loosened and the final tightening performed prior to loosening the next bolt in the sequence.

18. In the same sequence as used previously, loosen the cylinder head bolt three turns, then tighten the cylinder head bolt to the specific value according to its length. The short bolts should be tightened to 15-32 ft. lbs. (20-30 Nm) and the long bolts to 30-36 ft. lbs. (40-50 Nm). Finally tighten the cylinder head bolt an additional 175-185 degrees. It would be very helpful to utilize a degree socket wrench for this last step.

19. Lubricate the pushrods with clean engine oil prior to installation, then install them into their original positions.

20. Install the rocker arms. Tighten the rocker arm mounting bolts to 23-29 ft. lbs. (30-40 Nm).

21. If the valve train components were replaced with new components, inspect the valve clearance.

22. If installing the right-hand cylinder head, perform the following:

a. Position the alternator bracket in place, then install the 2 long bolts to 31-39 ft. lbs. (41-54 Nm). Install the short bolt and tighten to 18-22 ft. lbs. (24-31 Nm).

b. Install the idler pulley. Tighten the center retaining bolt to 35-46 ft. lbs. (47-63 Nm).

c. Install the alternator.

23. If installing the left-hand cylinder head, complete the following steps:

a. Position the A/C compressor bracket and power steering pump in place, then start the A/C compressor bracket bolt. Install the 3 compressor bracket bolts to 30-40 ft. lbs. (40-55 Nm). Then install the 2 compressor bracket nuts to 16-21 ft. lbs. (21-29 Nm).

b. Install the A/C compressor.

c. Install the power steering pump reservoir. Tighten the hold-down bolts to 80-107 inch lbs. (9-12 Nm).

24. Install the exhaust manifold.

25. Install the 2 rocker arm covers. Inspect the rocker arm cover gaskets for damage prior to installation; replace them if necessary.

26. Install the lower intake manifold and related components.

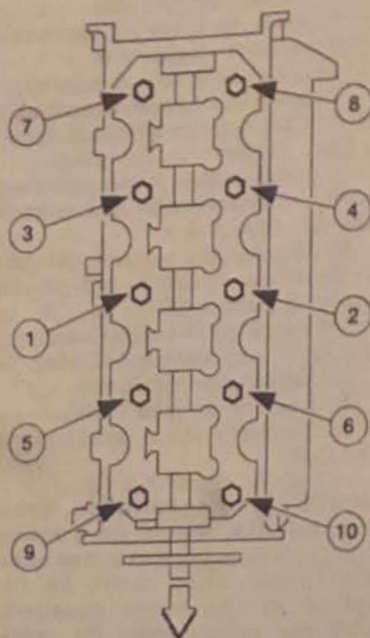
27. Install the upper intake manifold and related components.

28. Fill the cooling system and connect the negative battery cable.
29. Start the engine and check for any fuel, coolant and vacuum leaks.

4.6L Engines (VIN W and VIN 6)

NOTE: To correctly tighten the cylinder head bolts an angle torque wrench is needed.

1. If the vehicle is equipped with Air Conditioning (A/C), have the A/C system discharged by a qualified mechanic utilizing the appropriate refrigerant recovery/recycling machine.
2. Disconnect the negative battery cable.
3. Remove the cylinder head covers.
4. Remove the intake manifold.
5. Remove the timing chains from the engine.
6. Remove the exhaust manifolds.
7. Remove the 2 heater hose retaining bolts, then compress and slide the hose clamp back to remove the heater water hose.
8. Remove the 10 cylinder head bolts, then lift the cylinder head from the engine block. Discard the cylinder head gasket and clean the engine block surface.



Tighten the right-hand cylinder head bolts in all three steps using the sequence shown—4.6L (VIN W and VIN 6) engines

To install:

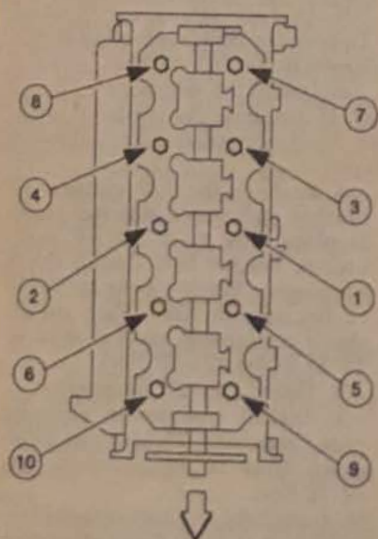
WARNING

Cylinder head bolts must be replaced with new ones. They are tighten-to-yield designed and cannot be reused.

9. Clean and inspect the cylinder head for damage or warpage. Install the cylinder head gasket over the dowel pins. Then install the cylinder head onto the engine block. Loosely install NEW cylinder head bolts.

NOTE: Make sure to tighten the head bolts in 3 steps.

10. Tighten the 10 cylinder head bolts in the sequence shown in 3 steps, as follows:
 - a. Step 1—27-31 ft. lbs. (37-43 Nm).
 - b. Step 2—tighten an additional 85-95 degrees.
 - c. Step 3—tighten another 85-95 degrees.
11. Install the heater water hose and slide the hose clamp back into position. Install the 2 heater water hose bolts.
12. Install the exhaust manifolds.
13. Install the timing chains.
14. Install the intake manifold.
15. Install the cylinder head covers.



Tighten the left-hand cylinder head bolts in all three steps using the sequence shown—4.6L (VIN W and VIN 6) engines

16. Connect the negative battery cable, then start the engine and check for leaks.

17. If the vehicle is equipped with A/C, have the system evacuated and recharged by a qualified mechanic utilizing the appropriate refrigerant recovery/recycling machine.

4.9L (VIN Y and Z) Engine

1. Drain the cooling system. Remove the hood.
2. Remove the throttle body inlet tubes.
3. Remove the air conditioning compressor.
4. Remove the condenser.
5. Disconnect the battery ground cable.
6. Disconnect the heater hoses from the water pump and coolant outlet housing.
7. Disconnect the fuel line at the fuel pump.
8. Remove the radiator.
9. Remove the engine fan and fan drive, the water pump pulley and the drive belt.
10. Disconnect the accelerator cable and retracting spring.
11. Disconnect the power brake hose at the manifold.
12. Disconnect the transmission kickdown rod on vehicles with automatic transmission.
13. Disconnect the muffler inlet pipe at the exhaust manifold. Pull the muffler inlet pipe down. Remove the gasket.
14. Disconnect the EEC harness from all the sensors.
15. Tag and disconnect all remaining wiring from the head and related components.
16. Remove the alternator, leaving the wires connected and position it out of the way.
17. Remove the air pump and bracket.
18. Remove the power steering pump and position it out of the way with the hoses still connected.
19. If the vehicle is equipped with an air compressor, bleed the 2 pressure lines and remove the compressor and bracket.
20. Remove the rocker arm cover.
21. Loosen the rocker arm bolts so they can be pivoted out of the way. Remove the pushrods in sequence so they can be identified and reinstalled in their original positions.
22. Disconnect the spark plug wires at the spark plugs.
23. Remove the cylinder head bolts and remove the cylinder head. Do not pry between the cylinder head and

the block as the gasket surfaces maybe damaged.

To install:

24. Clean the head and block gasket surfaces. If the cylinder head was removed for a gasket change, check the flatness of the cylinder head and block.

25. Position the gasket on the cylinder block.

26. Install a new gasket on the flange of the muffler inlet pipe.

27. Lift the cylinder head above the cylinder block and lower it into position using 2 head bolts installed through the head as guides.

28. Coat the threads of the Nos. 1 and 6 bolts for the right side of the cylinder head with a small amount of water-resistant sealer. Oil the threads of the remaining bolts. Install, but do not tighten, 2 bolts at the opposite ends of the head to hold the head and gasket in position.

29. The cylinder head bolts are tightened in 3 progressive steps. Torque them (in the proper sequence):

a. First tighten the bolts to 50-55 ft. lbs. (68-75 Nm).

b. Then tighten the cylinder head bolts to 60-65 ft. lbs. (82-88 Nm).

c. Finally, tighten the head bolts to 70-85 ft. lbs. (95-116 Nm).

30. Apply Lubriplate® to both ends of the pushrods and install them in their original positions.

31. Apply Lubriplate® to both the fulcrum and seat and position the rocker arms on the valves and pushrods.

32. Adjust the valves, as outlined below.

33. Install the rocker arm cover.

34. Install the air compressor and bracket.

35. Install the power steering pump.

36. Install the air pump and bracket.

37. Install the alternator.

38. Connect all wiring at the head and related components.

39. Connect the EEC harness to all the sensors.

40. Connect the muffler inlet pipe at the exhaust manifold.

41. Connect the transmission kickdown rod on vehicles with automatic transmission.

42. Connect the power brake hose at the manifold.

43. Connect the accelerator cable and retracting spring.

44. Install the water pump pulley, the engine fan and fan drive, and the drive belt.

45. Install the radiator.

46. Connect the fuel line at the fuel pump.

47. Connect the heater hoses at the water pump and coolant outlet housing.

48. Connect the battery ground cable.

49. Install the condenser.

50. Install the air conditioning compressor.

51. Install the throttle body inlet tubes.

52. Fill and bleed the cooling system.

53. Install the hood.

5.0L (VIN N) and 5.8L (VIN H and R) Engines

1. Drain the cooling system.

2. Remove the intake manifold and throttle body.

3. Remove the rocker arm cover(s).

4. If the right cylinder head is to be removed, lift the tensioner and remove the drive belt. Loosen the alternator adjusting arm bolt and remove the alternator mounting bracket bolt and spacer. Swing the alternator down and out of the way. Remove the air cleaner inlet duct.

If the left cylinder head is being removed, remove the air conditioning compressor. Persons not familiar with air conditioning systems should exercise extreme caution, perhaps leaving this job to a professional. Remove the oil dipstick and tube. Remove the cruise control bracket.

5. Disconnect the exhaust manifold(s) from the muffler inlet pipe(s).

6. Loosen the rocker arm stud nuts so the rocker arms can be rotated to the side. Remove the pushrods and identify them so they can be reinstalled in their original positions.

7. Disconnect the Thermactor® air supply hoses at the check valves. Cover the check valve openings.

8. Remove the cylinder head bolts and lift the cylinder head from the block. Remove the discard the gasket.

To install:

9. Clean the cylinder head, intake manifold, the valve cover and the head gasket surfaces.

10. A specially treated composition head gasket is used. Do not apply sealer to a composition gasket. Position the new gasket over the locating dowels on the cylinder block. Then, position the cylinder head on the block and install the attaching bolts.

11. The cylinder head bolts are tightened in progressive steps. Tighten all the bolts in the proper sequence to:

5.0L (VIN N) Engine

• Step 1 — 55-65 ft. lbs. (75-89 Nm)

• Step 2 — 66-72 ft. lbs. (90-98 Nm)

5.8L (VIN H and R) Engine

• Step 1 — 85 ft. lbs. (115 Nm)

• Step 2 — 95 ft. lbs. (129 Nm)

• Step 3 — 105-112 ft. lbs. (143-152 Nm)

12. Clean the pushrods. Blow out the oil passage in the rods with compressed air. Check the pushrods for straightness by rolling them on a piece of glass. Never try to straighten a pushrod; always replace it.

13. Apply Lubriplate® to the ends of the pushrods and install them in their original positions.

14. Apply Lubriplate® to the rocker arms and their fulcrum seats and install the rocker arms. Adjust the valves.

15. Position a new gasket(s) on the muffler inlet pipe(s) as necessary. Connect the exhaust manifold(s) at the muffler inlet pipe(s).

16. If the right cylinder head was removed, install the alternator, and air cleaner duct. Install the drive belt. If the left cylinder head was removed, install the compressor. Install the dipstick and cruise control bracket.

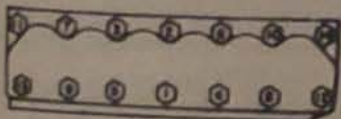
17. Clean the valve rocker arm cover and the cylinder head gasket surfaces. Place the new gaskets in the covers, making sure the tabs of the gasket engage the notches provided in the cover. Evacuate, charge and leak test the air conditioning system.

18. Install the intake manifold and related parts. Install the Thermactor® hoses.

19. Fill and bleed the cooling system.

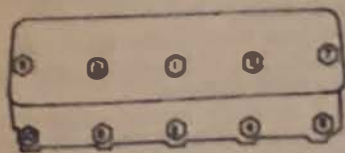
7.5L (VIN G) Engine

1. Drain the cooling system.



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Cylinder head bolt torque sequence — 4.9L (VIN Y and Z) engine



Cylinder Head Bolt Torque Sequence — 5.0L (VIN M), 5.0L (VIN H and R) and 7.5L (VIN G) Engines

2. Remove the upper and lower intake manifolds.

3. Disconnect the exhaust pipe from the exhaust manifold.

4. Loosen the air conditioning compressor drive belt, if equipped.

5. Loosen the alternator attaching bolts and remove the bolt attaching the alternator bracket to the right cylinder head.

6. Disconnect the air conditioning compressor from the engine and move it aside, out of the way. Do not discharge the air conditioning system.

7. Remove the bolts securing the power steering reservoir bracket to the left cylinder head. Position the reservoir and bracket out of the way. On motor home chassis, remove the oil filler tube.

8. Remove the valve rocker arm covers. Remove the rocker arm bolts, rocker arms, oil deflectors, fulcrums and pushrods in sequence so they can be reinstalled in their original positions.

9. Remove the cylinder head bolts and lift the head and exhaust manifold off the engine. If necessary, pry at the forward corners of the cylinder head against the casting bosses provided on the cylinder block. Do not damage the gasket mating surfaces of the cylinder head and block by prying against them.

To install:

10. Remove all gasket material from the cylinder head and block. Clean all gasket material from the mating surfaces of the intake manifold. If the exhaust manifold was removed, clean the mating surfaces of the cylinder head and exhaust manifold. Apply a thin coat of graphite grease to the cylinder head exhaust port areas and install the exhaust manifold.

11. Position 2 long cylinder head bolts in the 2 rear lower bolt holes of the left cylinder head. Place a long cylinder head bolt in the rear lower

bolt hole of the right cylinder head. Use rubber bands to keep the bolts in position until the cylinder heads are installed on the cylinder block.

12. Position new cylinder head gaskets on the cylinder block dowels. Do not apply sealer to the gaskets, heads, or block.

13. Place the cylinder heads on the block, guiding the exhaust manifold studs into the exhaust pipe connections. Install the remaining cylinder head bolts. The longer bolts go in the lower row of holes.

14. Tighten all the cylinder head attaching bolts in the proper sequence in 3 stages: 80-90 ft. lbs. (109-122 Nm), 100-110 ft. lbs. (136-149 Nm), and finally to 130-140 ft. lbs. (176-190 Nm). When this procedure is used, it is not necessary to retighten the heads after extended use.

15. Make sure the oil holes in the pushrods are open and install the pushrods in their original positions. Place a dab of Lubriplate® to the ends of the pushrods before installing them.

16. Lubricate and install the valve rockers. Make sure the pushrods remain seated in their lifters.

17. Connect the exhaust pipes to the exhaust manifolds.

18. Install the upper and lower intake manifolds.

19. Install the air conditioning compressor.

20. Install the power steering reservoir.

21. Apply oil-resistant sealer to one side of the new valve cover gaskets and lay the cemented side in place in the valve cover. Install the covers.

22. Install the alternator and adjust the drive belt.

23. Adjust the air conditioning compressor drive belt tension.

24. On motor home chassis, install the oil filler tube.

25. Fill and bleed the cooling system.

26. Start the engine and check for leaks.

Valve Lifters

REMOVAL AND INSTALLATION

4.2L (VIN 2) Engine

NOTE: If removing more than one valve lifter, mark the components for proper location.

1. Disconnect the negative battery cable.

2. Remove the lower intake manifold.

3. Remove the rocker arm cover.

4. Remove the rocker arm hold-down bolt, then remove the rocker arm from the cylinder head.

5. Remove the pushrod.

6. Remove the 2 lifter guide plate bolts, then remove the lifter guide plate and retainer.

7. Remove the valve lifter from its bore.

To install:

NOTE: Make certain to install the components in their original locations.

8. Lubricate the valve lifters and pushrods with clean engine oil before installation.

9. Insert the valve lifter into its respective bore, then install the retainer and guide plate. Tighten the guide plate mounting fasteners to 8-10 ft. lbs. (10-14 Nm).

10. Install the pushrods making sure that they are seated into the valve lifter recess fully.

11. Position the rocker arms in place, then install the hold-down bolts. Tighten the bolts to 23-29 ft. lbs. (30-40 Nm).

12. Install the rocker arm cover and the lower intake manifold.

13. Connect the negative battery cable.

4.9L (VIN Y and Z) Engine

1. Disconnect the inlet hose at the crankcase filler cap.

2. Remove the throttle body inlet tubes.

3. Disconnect the accelerator cable at the throttle body. Remove the cable retracting spring. Remove the accelerator cable bracket from the upper intake manifold and position the cable and bracket out of the way.

4. Remove the fuel line from the fuel rail. Be careful not to kink the line.

5. Remove the upper intake manifold and throttle body assembly.

6. Remove the ignition coil and wires.

7. Remove the rocker arm cover.

8. Remove the spark plug wires.

9. Remove the distributor cap.

10. Remove the pushrod cover (engine side cover).

11. Loosen the rocker arm bolts until the pushrods can be removed; keep them in order, for installation.

12. Using a magnetic lifter removal tool, remove the lifters. Wipe clean the exterior of each lifter as it's removed and mark it with an indelible marker, so it can be installed in its original bore.

To install:

13. Coat the bottom surface of each lifter with multi-purpose grease, and coat the rest of the lifter with clean oil.

14. Install each lifter in its original bore using the magnetic tool.

15. Coat each end of each pushrod with multi-purpose grease and install each in its original position. Make sure each pushrod is properly seated in the lifter socket.

16. Engage the rocker arms with the pushrods and tighten the rocker arm bolts enough to hold the pushrods in place.

17. Adjust the valve clearance.

18. Install the pushrod cover (engine side cover).

19. Install the distributor cap.

20. Install the spark plug wires.

21. Install the rocker arm cover.

22. Install the ignition coil and wires.

23. Install the upper intake manifold and throttle body assembly.

24. Install the fuel line at the fuel rail.

25. Install the accelerator cable bracket at the upper intake manifold. Install the cable retracting spring. Connect the accelerator cable at the throttle body.

26. Install the throttle body inlet tubes.

27. Connect the inlet hose at the crankcase filler cap.

5.0L (VIN N) and 5.8L (VIN H and R) Engines

NOTE: The 1993 5.0L (VIN N) engine uses roller lifters.

1. Remove the intake manifold.

2. Disconnect the Thermactor® air supply hose at the pump.

3. Remove the rocker arm covers.

4. Loosen the rocker arm fulcrum bolts until the rocker arms can be rotated off the pushrods.

5. Remove the pushrods and keep them in order, for installation.

6. Using a magnetic lifter removal tool, remove the lifters. Wipe clean the exterior of each lifter as it's removed and mark it with an indelible marker, so it can be installed in its original bore.

To install:

7. Coat the bottom surface of each lifter with multi-purpose grease, and coat the rest of the lifter with clean oil.

8. Install each lifter in its original bore using the magnetic tool.

9. Coat each end of each pushrod with multi-purpose grease and install each in its original position. Make

sure each pushrod is properly seated in the lifter socket.

10. Engage the rocker arms with the pushrods and tighten the rocker arm fulcrum bolts to 18-25 ft. lbs. (25-34 Nm). No valve adjustment should be necessary, however, if there is any question as to post-assembly collapsed lifter clearance, see the Hydraulic Lifter Clearance procedure below.

11. Install the rocker arm covers.

12. Connect the Thermactor® air supply hose at the pump.

13. Install the intake manifold.

7.5L (VIN G) Engine

1. Remove the intake manifold.

2. Remove the rocker arm covers.

3. Loosen the rocker arm fulcrum bolts until the rocker arms can be rotated off the pushrods.

4. Remove the pushrods and keep them in order, for installation.

5. Using a magnetic lifter removal tool, remove the lifters. Wipe clean the exterior of each lifter as it's removed and mark it with an indelible marker, so it can be installed in its original bore.

To install:

6. Coat the bottom surface of each lifter with multi-purpose grease, and coat the rest of the lifter with clean oil.

7. Install each lifter in its original bore using the magnetic tool.

8. Coat each end of each pushrod with multi-purpose grease and install each in its original position. Make sure each pushrod is properly seated in the lifter socket.

9. Rotate the crankshaft by hand until No. 1 piston is at TDC of compression. The firing order marks on the damper will be aligned at TDC with the timing pointer.

10. Engage the rocker arms with the pushrods and tighten the rocker arm fulcrum bolts to 18-25 ft. lbs. (25-34 Nm) in the following sequence:

- No. 1 intake and exhaust
- No. 3 intake
- No. 8 exhaust
- No. 7 intake
- No. 5 exhaust
- No. 8 intake
- No. 4 exhaust

11. Rotate the crankshaft 1 full turn — 360 degrees — and re-align the TDC mark and pointer. Tighten

the fulcrum bolt on the following valves:

- No. 2 intake and exhaust
- No. 4 intake
- No. 3 exhaust
- No. 5 intake
- No. 6 exhaust
- No. 6 intake
- No. 7 exhaust

12. Check the valve clearance as described under Hydraulic Valve Clearance, below.

13. Install the intake manifold.

14. Install the rocker arm covers.

Valve Lash

ADJUSTMENT

4.2L (VIN 2) and 4.6L Engines

The 4.2L (VIN 2) and 4.6L engine do not require valve lash adjusting, because they utilize hydraulic lash components in their valve actuation systems; the 4.2L (VIN 2) engine uses hydraulic valve lifters and the 4.6L engines utilize hydraulic lash adjusters, all of which automatically adjust the valve lash. No valve lash adjustment is necessary.

4.9L (VIN Y and Z) Engine

1. Rotate the crankshaft by hand so No. 1 piston is at TDC of the compression stroke. Make a chalk mark on the damper at that point, then, make 2 more chalk marks about 120 degrees apart, dividing the damper into 3 equal parts.

2. With No. 1 at TDC, tighten the rocker arm bolts on No. 1 cylinder intake and exhaust to 17-23 ft. lbs. (23-31 Nm). Then, slowly apply pressure, using Lifter Bleed-down wrench T70P-6513-A, or equivalent, to completely bottom the lifter. Take care to avoid excessive pressure that might bend the pushrod. Hold the lifter in this position and check the clearance between the rocker arm and the valve stem tip. Allowable clearance is 0.10-0.20 in. (2.5-5.0mm) with a desired clearance of 0.125-0.175 in. (3.0-4.5mm).

3. If the clearance is less than specified, install a shorter pushrod. If the clearance is greater than specified, install a longer pushrod.

4. Rotate the crankshaft clockwise — viewed from the front — until the next chalk mark is aligned with the timing pointer. Repeat the procedure for No. 5 intake and exhaust.

5. Rotate the crankshaft to the next chalk mark and repeat the procedure for No. 3 intake and exhaust.

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6. Repeat the rotation/checking procedure for the remaining valves in firing order, that is: 6-2-4.

5.0L (VIN N) Engine

1. Rotate the crankshaft by hand so No. 1 piston is at TDC of the compression stroke. Make a chalk mark on the damper at that point, then, make 2 more chalk marks about 90 degrees apart in a clockwise direction.

2. With No. 1 at TDC, slowly apply pressure, using Lifter Bleed-down wrench T70P-6513-A, or equivalent, to completely bottom the lifter, on the following valves:

- No. 1 intake and exhaust
- No. 7 intake
- No. 5 exhaust
- No. 8 intake
- No. 4 exhaust

Take care to avoid excessive pressure that might bend the pushrod. Hold the lifter in this position and check the clearance between the rocker arm and the valve stem tip. Allowable clearance is 0.071-0.193 in. (1.8-4.9mm) with a desired clearance of 0.096-0.165 in. (2.4-4.2mm).

3. If the clearance is less than specified, install a shorter pushrod. If the clearance is greater than specified, install a longer pushrod.

4. Rotate the crankshaft clockwise — viewed from the front — 180 degrees, until the next chalk mark is aligned with the timing pointer. Repeat the procedure for:

- No. 5 intake
- No. 2 exhaust
- No. 4 intake
- No. 6 exhaust



Valve clearance adjustment positions on the crankshaft damper — 4.9L (VIN Y and Z) engine

5. Rotate the crankshaft to the next chalk mark — 90 degrees — and repeat the procedure for:

- No. 2 intake
- No. 7 exhaust
- No. 3 intake and exhaust
- No. 6 intake
- No. 8 exhaust

5.8L (VIN H and R) Engine

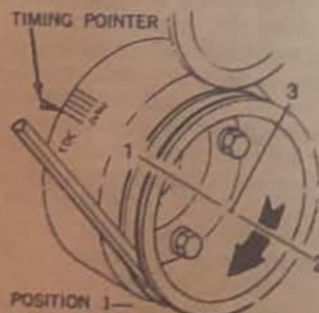
1. Rotate the crankshaft by hand so No. 1 piston is at TDC of the compression stroke. Make a chalk mark on the damper at that point, then, make 2 more chalk marks about 90 degrees apart in a clockwise direction.

2. With No. 1 at TDC, slowly apply pressure, using Lifter Bleed-down wrench T70P-6513-A, or equivalent, to completely bottom the lifter, on the following valves:

- No. 1 intake and exhaust
- No. 4 intake
- No. 3 exhaust
- No. 8 intake
- No. 7 exhaust

Take care to avoid excessive pressure that might bend the pushrod. Hold the lifter in this position and check the clearance between the

WITH NO. 1 AT TDC AT THE END OF THE COMPRESSION STROKE MAKE A CHALK MARK AT POINTS 2 AND 3 APPROXIMATELY 90 DEGREES APART.



POSITION 1 — NO. 1 AT TDC AT THE END OF THE COMPRESSION STROKE

POSITION 2 — ROTATE THE CRANKSHAFT 180 DEGREES (ONE HALF REVOLUTION) CLOCKWISE FROM POSITION 1

POSITION 3 — ROTATE THE CRANKSHAFT 270 DEGREES (THREE QUARTER REVOLUTION) CLOCKWISE FROM POSITION 2

Valve clearance adjustment positions on the crankshaft damper/pulley — 5.0L (VIN N), 5.8L (VIN H and R) and 7.5L (VIN G) engines

rocker arm and the valve stem tip. Allowable clearance is 0.098-0.1 in. (2.5-5.0mm) with a desired clearance of 0.123-0.173 in. (3.1-4.4mm).

3. If the clearance is less than specified, install a shorter pushrod. If the clearance is greater than specified, install a longer pushrod.

4. Rotate the crankshaft clockwise — viewed from the front — 180 degrees, until the next chalk mark is aligned with the timing pointer. Repeat the procedure for:

- No. 3 intake
- No. 2 exhaust
- No. 7 intake
- No. 6 exhaust

5. Rotate the crankshaft to the next chalk mark — 90 degrees — and repeat the procedure for:

- No. 2 intake
- No. 4 exhaust
- No. 5 intake and exhaust
- No. 6 intake
- No. 8 exhaust

7.5L (VIN G) Engine

1. Rotate the crankshaft by hand so No. 1 piston is at TDC of the compression stroke. Make a chalk mark on the damper at that point.

2. With No. 1 at TDC, slowly apply pressure, using Lifter Bleed-down wrench T70P-6513-A, or equivalent, to completely bottom the lifter, on the following valves:

- No. 1 intake and exhaust
- No. 3 intake
- No. 4 exhaust
- No. 7 intake
- No. 5 exhaust
- No. 8 intake and exhaust

Take care to avoid excessive pressure that might bend the pushrod. Hold the lifter in this position and check the clearance between the rocker arm and the valve stem tip. Allowable clearance is 0.075-0.17 in. (1.9-4.4mm) with a desired clearance of 0.100-0.150 in. (2.5-3.8mm).

3. If the clearance is less than specified, install a shorter pushrod. If the clearance is greater than specified, install a longer pushrod.

4. Rotate the crankshaft clockwise — viewed from the front — 180 degrees, until the chalk mark is once again aligned with the timing pointer. Repeat the procedure for:

- No. 2 intake and exhaust
- No. 4 intake
- No. 3 exhaust
- No. 5 intake
- No. 7 exhaust
- No. 6 intake and exhaust

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6. Repeat the rotation/checking procedure for the remaining valves in firing order, that is: 6-2-4.

5.0L (VIN N) Engine

1. Rotate the crankshaft by hand so No. 1 piston is at TDC of the compression stroke. Make a chalk mark on the damper at that point, then, make 2 more chalk marks about 90 degrees apart in a clockwise direction.

2. With No. 1 at TDC, slowly apply pressure, using Lifter Bleed-down wrench T70P-6513-A, or equivalent, to completely bottom the lifter, on the following valves:

- No. 1 intake and exhaust
- No. 7 intake
- No. 5 exhaust
- No. 8 intake
- No. 4 exhaust

Take care to avoid excessive pressure that might bend the pushrod. Hold the lifter in this position and check the clearance between the rocker arm and the valve stem tip. Allowable clearance is 0.071-0.193 in. (1.8-4.9mm) with a desired clearance of 0.096-0.165 in. (2.4-4.2mm).

3. If the clearance is less than specified, install a shorter pushrod. If the clearance is greater than specified, install a longer pushrod.

4. Rotate the crankshaft clockwise — viewed from the front — 180 degrees, until the next chalk mark is aligned with the timing pointer. Repeat the procedure for:

- No. 5 intake
- No. 2 exhaust
- No. 4 intake
- No. 6 exhaust



Valve clearance adjustment positions on the crankshaft damper — 4.9L (VIN Y and Z) engine

5. Rotate the crankshaft to the next chalk mark — 90 degrees — and repeat the procedure for:

- No. 2 intake
- No. 7 exhaust
- No. 3 intake and exhaust
- No. 6 intake
- No. 8 exhaust

5.0L (VIN H and R) Engine

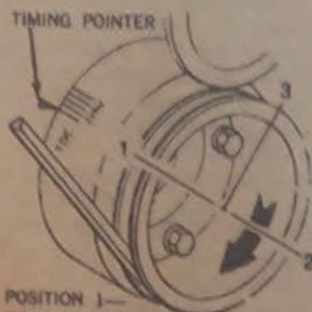
1. Rotate the crankshaft by hand so No. 1 piston is at TDC of the compression stroke. Make a chalk mark on the damper at that point, then, make 2 more chalk marks about 90 degrees apart in a clockwise direction.

2. With No. 1 at TDC, slowly apply pressure, using Lifter Bleed-down wrench T70P-6513-A, or equivalent, to completely bottom the lifter, on the following valves:

- No. 1 intake and exhaust
- No. 4 intake
- No. 3 exhaust
- No. 8 intake
- No. 7 exhaust

Take care to avoid excessive pressure that might bend the pushrod. Hold the lifter in this position and check the clearance between the

WITH NO. 1 AT TDC AT THE END OF THE COMPRESSION STROKE MAKE A CHALK MARK AT POINTS 2 AND 3 APPROXIMATELY 90 DEGREES APART.



POSITION 1 — NO. 1 AT TDC AT THE END OF THE COMPRESSION STROKE

POSITION 2 — ROTATE THE CRANKSHAFT 180 DEGREES (ONE HALF REVOLUTION) CLOCKWISE FROM POSITION 1

POSITION 3 — ROTATE THE CRANKSHAFT 270 DEGREES (THREE QUARTER REVOLUTION) CLOCKWISE FROM POSITION 2

Valve clearance adjustment positions on the crankshaft damper/pulley — 5.0L (VIN H), 5.8L (VIN H and R) and 7.5L (VIN G) engines

rocker arm and the valve stem tip. Allowable clearance is 0.098-0.198 in. (2.5-5.0mm) with a desired clearance of 0.123-0.173 in. (3.1-4.4mm).

3. If the clearance is less than specified, install a shorter pushrod. If the clearance is greater than specified, install a longer pushrod.

4. Rotate the crankshaft clockwise — viewed from the front — 180 degrees, until the next chalk mark is aligned with the timing pointer. Repeat the procedure for:

- No. 3 intake
- No. 2 exhaust
- No. 7 intake
- No. 6 exhaust

5. Rotate the crankshaft to the next chalk mark — 90 degrees — and repeat the procedure for:

- No. 2 intake
- No. 4 exhaust
- No. 5 intake and exhaust
- No. 6 intake
- No. 8 exhaust

7.5L (VIN G) Engine

1. Rotate the crankshaft by hand so No. 1 piston is at TDC of the compression stroke. Make a chalk mark on the damper at that point.

2. With No. 1 at TDC, slowly apply pressure, using Lifter Bleed-down wrench T70P-6513-A, or equivalent, to completely bottom the lifter, on the following valves:

- No. 1 intake and exhaust
- No. 3 intake
- No. 4 exhaust
- No. 7 intake
- No. 5 exhaust
- No. 8 intake and exhaust

Take care to avoid excessive pressure that might bend the pushrod. Hold the lifter in this position and check the clearance between the rocker arm and the valve stem tip. Allowable clearance is 0.075-0.175 in. (1.9-4.4mm) with a desired clearance of 0.100-0.150 in. (2.5-3.8mm).

3. If the clearance is less than specified, install a shorter pushrod. If the clearance is greater than specified, install a longer pushrod.

4. Rotate the crankshaft clockwise — viewed from the front — 360 degrees, until the chalk mark is once again aligned with the timing pointer. Repeat the procedure for:

- No. 2 intake and exhaust
- No. 4 intake
- No. 3 exhaust
- No. 5 intake
- No. 7 exhaust
- No. 6 intake and exhaust

Rocker Arm

REMOVAL AND INSTALLATION

4.9L (VIN Y and Z) Engine

1. Disconnect the inlet hose at the crankcase filler cap.

2. Remove the throttle body inlet tubes.

3. Disconnect the accelerator cable at the throttle body. Remove the cable retracting spring. Remove the accelerator cable bracket from the upper intake manifold and position the cable and bracket out of the way.

4. Remove the fuel line from the fuel rail. Be careful not to kink the line.

5. Remove the upper intake manifold and throttle body assembly.

6. Remove the ignition coil and wires.

7. Remove the rocker arm cover.

8. Remove the spark plug wires.

9. Remove the distributor cap.

10. Remove the pushrod cover (engine side cover).

11. Remove the rocker arm bolts, then lift the rocker arms off of the cylinder head; keep the rocker arms in order for installation.

To install:

12. Engage the rocker arms with the pushrods and tighten the rocker arm bolts enough to hold the pushrods in place.

13. Adjust the valve clearance.

14. Install the pushrod cover (engine side cover).

15. Install the distributor cap.

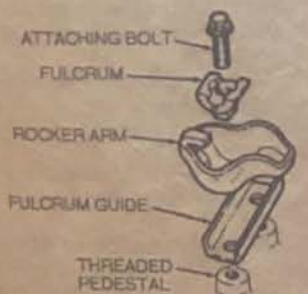
16. Install the spark plug wires.

17. Install the rocker arm cover.

18. Install the ignition coil and wires.

19. Install the upper intake manifold and throttle body assembly.

20. Install the fuel line at the fuel rail.



Exploded view of the rocker arm components—4.9L (VIN Y and Z) engine

21. Install the accelerator cable bracket on the upper intake manifold. Install the cable retracting spring. Connect the accelerator cable at the throttle body.

22. Install the throttle body inlet tubes.

23. Connect the inlet hose at the crankcase filler cap.

5.0L (VIN N) and 5.8L (VIN H and R) Engines

1. Remove the intake manifold.

2. Disconnect the Thermactor® air supply hose at the pump.

3. Remove the rocker arm covers.

4. Loosen the rocker arm fulcrum bolts, fulcrum seats and rocker arms; keep all parts in order for installation.

To install:

5. Apply multi-purpose grease to the valve stem tips, the fulcrum seats and sockets.

6. Install the fulcrum guides, rocker arms, seats and bolts. Torque the bolts to 18–25 ft. lbs. (25–34 Nm).

7. Install the rocker arm covers.

8. Connect the Thermactor® air supply hose at the pump.

9. Install the intake manifold.

7.5L (VIN G) Engine

1. Remove the intake manifold.

2. Remove the rocker arm covers.

3. Loosen the rocker arm fulcrum bolts, fulcrum, oil deflector, seat and rocker arms; keep everything in order for installation.

To install:

4. Coat each end of each pushrod with multi-purpose grease.

5. Coat the top of the valve stems, the rocker arms and the fulcrum seats with multi-purpose grease.

6. Rotate the crankshaft by hand until No. 1 piston is at TDC of compression. The firing order marks on the damper will be aligned at TDC with the timing pointer.

7. Install the rocker arms, seats, deflectors and bolts on the following valves:

- No. 1 intake and exhaust
- No. 3 intake
- No. 8 exhaust
- No. 7 intake
- No. 5 exhaust
- No. 8 intake
- No. 4 exhaust

8. Engage the rocker arms with the pushrods and tighten the rocker arm fulcrum bolts to 18–25 ft. lbs. (25–34 Nm).

9. Rotate the crankshaft on full turn—360 degrees—and re-align the TDC mark and pointer. Install

the parts and tighten the bolts on the following valves:

- No. 2 intake and exhaust
- No. 4 intake
- No. 3 exhaust
- No. 5 intake
- No. 6 exhaust
- No. 6 intake
- No. 7 exhaust

10. Install the rocker arm covers.

11. Install the intake manifold.

12. Check the valve clearance as described under Hydraulic Valve Clearance, below.

Intake Manifold

REMOVAL AND INSTALLATION

NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 10 miles (16 km) or more to relearn the strategy.

4.2L (VIN 2) Engine

1. Remove the engine air cleaner outlet tube.

2. Detach the following ignition coil electrical connections:

a. Ignition coil electrical connector.

b. Radio ignition interference capacitor electrical connector.

3. Label, then detach the 6 spark plug wires.

4. Remove the accelerator control splash shield.

5. Disconnect the accelerator cable end and, if equipped, the speed control actuator cable end.

6. Remove the accelerator cable and actuator cable end, after removing the hold-down bolts.

7. Disconnect the Vapor Management Valve (VMV) hose.

8. Disconnect the brake booster vacuum hose.

9. Disconnect the manifold vacuum connection.

10. Remove the PCV valve from the rocker arm cover.

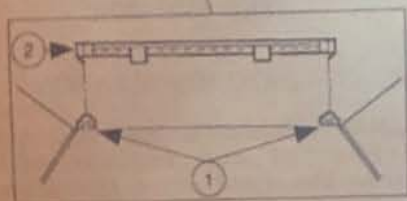
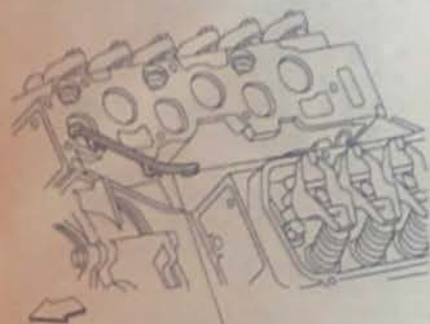
11. Position the Engine Vacuum Regulator (EVR) bracket aside.

12. Detach the throttle position sensor and idle air control valve electrical connectors.

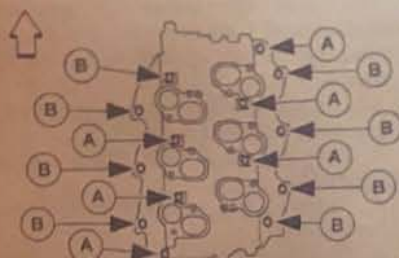
13. Remove the breather from the rocker arm cover.

14. Remove the 12 upper intake manifold retaining bolts, then lift the manifold off of the engine. Discard the intake manifold upper gasket.

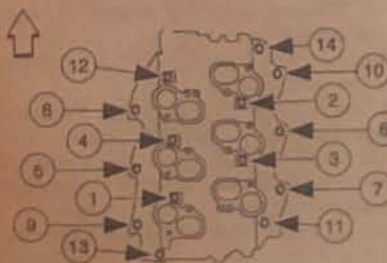
5 FORD MOTOR CO. BRONCO/E-SERIES VAN/EXPEDITION



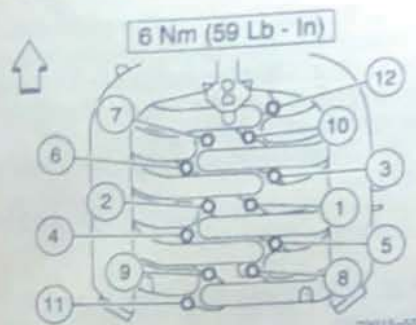
Apply the sealant to the intake manifold/cylinder head seams for the intake manifold end seals as shown — 4.2L (VIN 2) engine



Make certain to install the long bolts (A) and the short bolts (B) in the correct lower intake manifold holes — 4.2L (VIN 2) engine



Tighten the lower manifold bolts in the sequence shown — 4.2L (VIN 2) engine



Tighten the upper intake manifold mounting bolts in the sequence shown — 4.2L (VIN 2) engine

15. Detach the 6 fuel injector electrical connectors.

16. Detach the engine coolant temperature sensor and the water temperature indicator sending unit electrical connectors.

17. Disconnect the EGR valve vacuum hose.

18. Remove the EGR valve tube upper fitting.

19. Remove the radiator hose from the lower intake manifold.

20. Position the Intake Manifold Runner Control (IMRC) actuator brackets aside.

21. Disconnect the fuel pressure regulator vacuum line.

22. Disconnect the fuel lines.

23. Disconnect the water pump bypass hose.

NOTE: Remove the lower intake manifold with the fuel injection supply manifold and fuel injectors as one unit.

24. Remove the 6 long bolts and the 8 short bolts, then lift the lower intake manifold off of the engine.

25. Remove and discard the lower intake manifold sealing components.

To install:

26. Clean all components of dirt, grease and old gasket material.

27. Install the lower intake manifold front and rear end seals as follows:

a. Apply a bead of sealant (Silicone Gasket and Sealant F6AZ-19562-A or equivalent) to the intake manifold front and rear end seal mounting points as illustrated.

b. Install the lower intake manifold front and rear end seals.

28. Install new lower intake manifold gaskets onto the cylinder heads.

NOTE: The lower intake manifold must be installed within 15 minutes of applying sealant.

29. Apply a bead of the same sealant to the end of the lower intake manifold end seals, where they stop

on the cylinder head surface. Position the intake manifold onto the engine block and cylinder heads.

30. Install the lower intake manifold mounting bolts in the correct positions. Refer to the illustration for the correct placement of the long (A) and the short (B) mounting bolts.

NOTE: Make sure to tighten the intake manifold bolts in 2 steps.

31. Tighten the lower intake manifold mounting bolts in the sequence shown, first to 44 inch lbs. (5 Nm), then to 71-101 inch lbs. (8.0-11.5 Nm).

32. Connect the water bypass hose.

33. Connect the fuel lines.

34. Connect the fuel pressure regulator vacuum line.

35. Install the IMRC actuators. Tighten the bolts on the brackets to 71-102 inch lbs. (8.0-11.5 Nm).

36. Install the upper radiator hose to the lower intake manifold.

37. Connect the EGR valve vacuum hose.

38. Install the EGR tube upper fitting to 25-34 ft. lbs. (37-47 Nm).

39. Attach the engine coolant temperature sensor and water temperature indicator sending unit electrical connectors.

40. Install the 6 fuel injector electrical connectors.

41. Install a new intake manifold upper gasket.

NOTE: Make sure to tighten the upper intake manifold bolts in the sequence shown.

42. Position the upper intake manifold onto the lower intake manifold, then tighten the upper intake manifold bolts in the sequence shown to 59 inch lbs. (6 Nm). Tighten the upper intake manifold bolts to 6-8 ft. lbs. (8.0-11.5 Nm) in the sequence shown.

43. Install the breather into the rocker arm cover.

44. Attach the throttle position sensor and idle air control valve electrical connectors.

45. Install the Engine Vacuum Regulator (EVR) bracket.

46. Attach the manifold vacuum connection.

47. Install the PCV valve.

48. Connect the brake booster vacuum hose.

49. Connect the Vapor Management Valve (VMV) hose.

50. Install the accelerator and speed actuator cables.

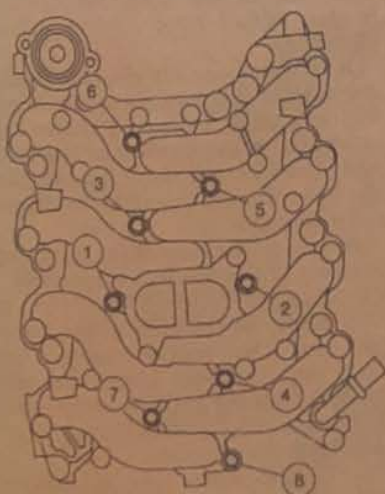
51. Install the accelerator control splash shield.

52. Install the spark plug wires.

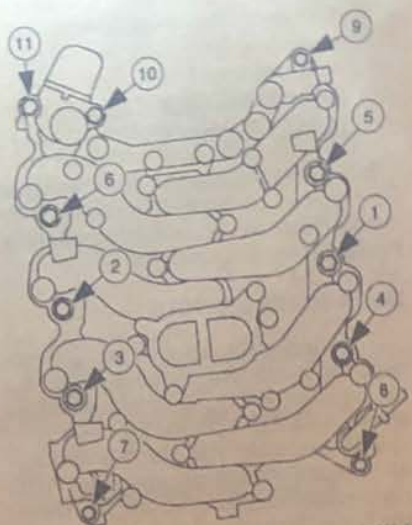
53. Attach the ignition coil and the radio ignition interference capacitor electrical connectors.
54. Install the engine air cleaner outlet tube.

4.6L Engine (VIN W and VIN 6)

1. Disconnect the negative battery cable.
2. Relieve the fuel system pressure.
3. Drain the cooling system.
4. Disconnect the upper radiator hose from the intake manifold.
5. Remove the engine air cleaner outlet tube.
6. Disconnect the accelerator cable from the bracket and the throttle body cam.
7. If equipped, remove the speed control actuator cable from the throttle body.
8. Disconnect all vacuum hoses, fuel lines and electrical wires from the throttle body and intake manifold.
9. Remove the brake booster vacuum hose bracket.
10. Remove the EGR valve-to-exhaust manifold tube.
11. Detach the fuel injector electrical connectors.
12. Label, then remove the spark plug wires, if necessary.



Tighten the lower-to-upper intake manifold bolts in 2 steps following the sequence shown — 4.6L engines (VIN W and VIN 6)



Tighten the upper intake manifold-to-cylinder head mounting bolts in the sequence shown — 4.6L engines (VIN W and VIN 6)

13. Remove the accessory drive belt.
14. Remove the alternator.
15. Remove the power steering oil reservoir bracket and set aside.
16. Disconnect the heater water hose from the intake manifold.
17. Remove the 11 intake manifold bolts.
18. Lift the intake manifold off of the engine, then detach the Intake Manifold Tuning Valve (IMTV) electrical connector. Remove and discard the upper intake manifold gaskets.
19. Remove the 8 lower intake manifold bolts, then separate the upper intake manifold from the lower intake manifold. Discard the old gasket.
20. Position the lower intake manifold gasket and the upper intake manifold onto the lower intake manifold, then loosely install the 8 lower intake-to-upper intake manifold bolts.

NOTE: Make sure to tighten the lower-to-upper manifold bolts in 2 steps.

21. Tighten the 8 lower-to-upper intake manifold bolts in 2 steps following the tightening sequence shown. The first step should be to 18 inch lbs. (2 Nm) and the second step to 6-8 inch lbs. (8-12 Nm).

22. Position the 2 upper intake manifold gaskets on the cylinder heads. Set the upper intake manifold in place on the engine, then loosely install the 9 intake manifold-to-cylinder head bolts.

23. Attach the IMTV electrical connector.

NOTE: Check that the thermostat housing is in the correct position before the thermostat housing is installed.

24. Install the thermostat housing and start the 2 housing bolts.

NOTE: Make certain to tighten the intake manifold in 2 steps.

25. Tighten the 11 intake manifold bolts in the sequence shown, first to 18 inch lbs. (2 Nm) then to 15-22 ft. lbs. (20-30 Nm).

26. Install the heater water hose.
27. Position the power steering bracket and install the power steering pump bracket bolts to 71-107 inch lbs. (8-12 Nm).

28. Attach all electrical connections, fuel lines, vacuum tubes and coolant hoses to the intake manifold, fuel injectors and throttle body assembly.

29. Install the alternator and the accessory drive belt.

30. Install the spark plug wires.
31. Install the EGR valve-to-exhaust manifold tube. The tube fittings should be tightened to 26-33 ft. lbs. (35-45 Nm).

32. Install the speed actuator cable, if equipped, and the accelerator cable to the throttle body.

33. Install the engine air cleaner outlet tube.

34. Install the heater water hose.
35. Fill the cooling system with the correct amount and type of coolant.
36. Connect the negative battery cable. Start the engine and check for fuel, vacuum or coolant leaks.

4.9L (VIN Y and Z) Engine

NOTE: The lower intake manifold and the exhaust manifold on the 4.9L (VIN Y and Z) engines is considered a combination manifold. Only the upper intake manifold is covered here.

1. Disconnect the negative battery cable.
2. Label, then detach all electrical connectors from the intake manifold, throttle body and EGR valve.
3. Disconnect all vacuum lines attached to the intake manifold, the throttle body and the EGR valve.
4. Label the 2 EGR transducer hoses, then remove the transducer

hose bracket. Disconnect the transducer hoses.

5. Disconnect the PCV hose from the fitting, located on the underside of the upper intake manifold.

WARNING

When disconnecting the throttle cable from the ball stud, use a pry tool or similar tool close to the ball stud to pry it off. Removing it by hand may damage the cable.

6. Remove the accelerator control splash shield, then disconnect the accelerator cable and speed actuator cable from the throttle body. Position the cables away from the engine.

7. Disconnect the air cleaner outlet tube from the throttle body.

8. Remove the EGR valve-to-exhaust manifold tube.

9. Remove the bolt and washer attaching the intake manifold support to the upper intake manifold.

10. Remove the 7 studs that retain the upper intake manifold.

11. Remove the upper intake manifold and throttle body from the lower intake manifold.

To install:

12. Position a new intake manifold upper gasket on the lower intake manifold, using the lower manifold dowels to position the intake manifold upper gasket.

13. Position the upper intake manifold onto the lower intake manifold. Install the 7 studs to attach the upper manifold to the lower manifold hand-tight.

14. Tighten the 7 upper manifold-to-lower manifold studs to 12-18 ft. lbs. (16-24 Nm).

15. Install the upper manifold support and tighten the mounting bolt to 22-32 ft. lbs. (30-43 Nm).

16. Install the EGR valve-to-exhaust manifold tube. The tube is routed between lower intake manifold runners No. 5 and No. 6. Tighten both of the fittings to 25-35 ft. lbs. (34-47 Nm).

17. Attach the PCV hose to the fitting, located on the valve cover under the upper intake manifold.

18. Connect the accelerator cable, transmission kickdown cable, and speed control actuator cable. Install the accelerator control splash shield.

19. Connect the air cleaner outlet tube to the throttle body.

20. Install the EGR transducer and bracket. Tighten the bolts to 12-18 ft. lbs. (17-24 Nm). Connect the EGR transducer hoses.

21. Reattach all of the vacuum lines removed from the throttle body, the

intake manifold and the EGR valve assemblies. Also install all of the electrical connections to the same components.

22. Connect the negative battery cable.

5.0L (VIN N), 5.8L (VIN H and R) and 7.5L (VIN G) Engines

NOTE: Discharge fuel system pressure before starting any work that involves disconnecting fuel system lines.

UPPER INTAKE MANIFOLD

1. Remove the air cleaner. Disconnect the electrical connectors at the air bypass valve, throttle position sensor and EGR position sensor.

2. Disconnect the throttle linkage at the throttle ball and the AOD transmission linkage from the throttle body. Remove the bolts that secure the bracket to the intake and position the bracket and cables out of the way.

3. Disconnect the upper manifold vacuum fitting connections by removing all the vacuum lines at the vacuum tree (label lines for position identification). Remove the vacuum lines to the EGR valve and fuel pressure regulator.

4. Disconnect the PCV system by disconnecting the hose from the fitting at the rear of the upper manifold.

5. Remove the 2 canister purge lines from the fittings at the throttle body.

6. Disconnect the EGR tube from the EGR valve by loosening the flange nut.

7. Remove the bolt from the upper intake support bracket to upper manifold. Remove the upper manifold retaining bolts and remove the upper intake manifold and throttle body as an assembly.

8. Clean and inspect all mounting surfaces of the upper and lower intake manifolds.

To install:

9. Position a new mounting gasket on the lower intake manifold.

10. Install the upper intake manifold and throttle body as an assembly. Install the upper manifold retaining bolts and install the bolt at the upper intake support bracket. Mounting bolts are torqued to 12-18 ft. lbs. (16-25 Nm).

11. Connect the EGR tube at the EGR valve.

12. Install the 2 canister purge lines at the fittings at the throttle body.

13. Connect the PCV system hose at the fitting at the rear of the upper manifold.

14. Connect the upper manifold vacuum lines at the vacuum tree. Install the vacuum lines at the EGR valve and fuel pressure regulator.

15. Install the throttle bracket on the intake manifold. Connect the throttle linkage at the throttle ball and the AOD transmission linkage at the throttle body.

16. Connect the electrical connectors at the air bypass valve, throttle position sensor and EGR position sensor.

17. Install the air cleaner.

UPPER INTAKE MANIFOLD

1. Upper manifold and throttle body must be removed first.

2. Drain the cooling system.

3. Remove the distributor assembly, cap and wires.

4. Disconnect the electrical connectors at the engine, coolant temperature sensor and sending unit, at the air charge temperature sensor and at the knock sensor.

5. Disconnect the injector wiring harness from the main harness assembly. Remove the ground wire from the intake manifold stud. The ground wire must be installed at the same position it was removed from.

6. Disconnect the fuel supply and return lines from the fuel rails.

7. Remove the upper radiator hose from the thermostat housing. Remove the bypass hose. Remove the heater outlet hose at the intake manifold.

8. Remove the air cleaner mounting bracket. Remove the intake manifold mounting bolts and studs. Pay attention to the location of the bolts and studs for reinstallation. Remove the lower intake manifold assembly.

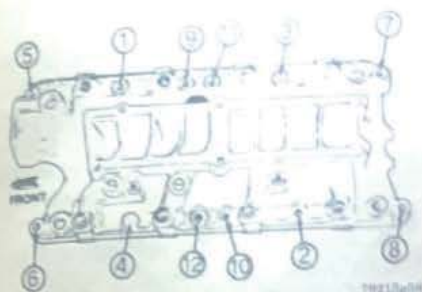
To install:

9. Clean and inspect the mounting surfaces of the heads and manifold.

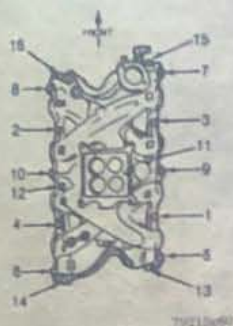
10. Apply a 1/16 in. (1.5mm) bead of RTV sealer to the ends of the manifold seal (the junction point of the seals and gaskets). Install the end seals and intake gaskets on the cylinder heads. The gaskets must interlock with the seal tabs.

11. Install locator bolts at opposite ends of each head and carefully lower the intake manifold into position. Install and tighten the mounting bolts and studs to 23-25 ft. lbs. (31-34 Nm).

12. Install the lower intake manifold assembly. Install the intake manifold mounting bolts and studs. Pay attention to the location of the



Lower intake manifold bolt sequence — 5.0L (VIN N) and 5.8L (VIN H and R) engines



Intake manifold bolt torque sequence — 7.5L (VIN G) engine

bolts. Install the air cleaner mounting bracket.

13. Install the heater outlet hose at the intake manifold.

14. Install the bypass hose.

15. Install the upper radiator hose.

16. Connect the fuel supply and return lines at the fuel rails.

17. Connect the injector wiring harness from the main harness assembly. Install the ground wire from the intake manifold stud.

18. Connect the electrical connectors at the engine, coolant temperature sensor and sending unit, at the air charge temperature sensor and at the knock sensor.

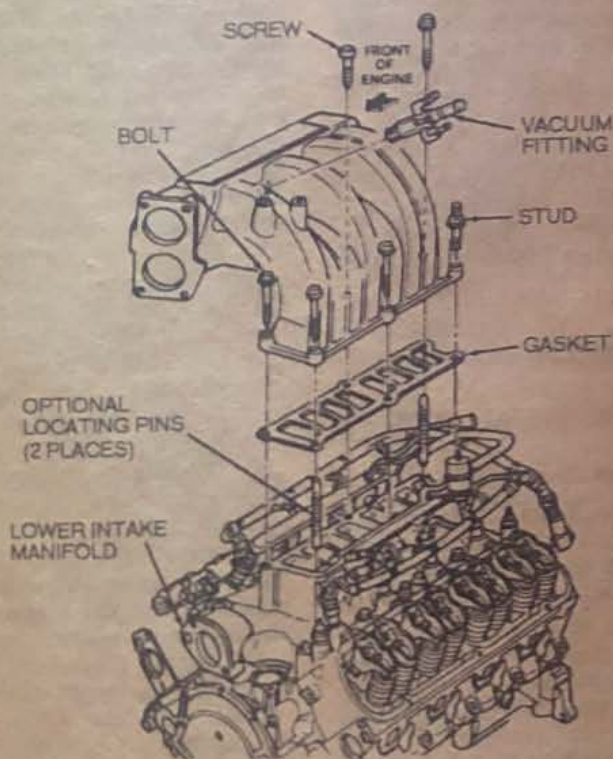
19. Install the distributor assembly, cap and wires.

20. Fill the cooling system.

Exhaust Manifold

REMOVAL AND INSTALLATION

NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 10 miles (16 km) or more to relearn the strategy.



Upper intake manifold installation — 5.0L (VIN N) and 5.8L (VIN H and R) engines

4.2L (VIN 2) Engine

1. Disconnect the negative battery cable.

2. For the right-hand manifold, remove the EGR valve-to-exhaust manifold tube.

3. For the left-hand manifold, remove the oil level indicator tube bracket nut, then remove the oil level indicator tube. Remove and discard the oil level indicator tube O-ring.

4. Raise and safely support the front of the vehicle on jackstands.

5. Detach the heated oxygen sensor electrical connector.

6. Remove the 2 catalytic converter-to-exhaust manifold nuts, then disconnect the Y-pipe from the left-hand exhaust manifold.

7. Remove the exhaust manifold stud bolts, then remove the manifold mounting bolts. Remove the exhaust manifold. Remove and discard the exhaust manifold gasket.

To install:

8. Position the new exhaust manifold gasket onto the engine, then install the exhaust manifold. Tighten the bolts and stud bolts in the sequence shown to 15–22 ft. lbs. (20–30 Nm).

9. Connect the Y-pipe to the exhaust manifold, then install and tighten the catalytic converter nuts to 25–34 ft. lbs. (34–46 Nm).

10. Attach the oxygen sensor connector, then lower the vehicle.

11. For the left-hand exhaust manifold, install a new oil level indicator tube O-ring onto the tube. Insert the tube into the engine block and tighten the bracket retaining nut to 15–22 ft. lbs. (20–30 Nm).

12. For the right-hand exhaust manifold, install the EGR valve-to-exhaust manifold tube. Tighten the upper and lower fittings to 25–34 ft. lbs. (34–47 Nm).

13. Connect the negative battery cable.

4.6L Engines (VIN W and VIN 6)

1. Raise and safely support the vehicle on jackstands.

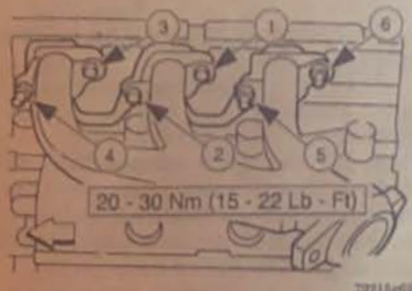
2. Remove the front fender splash shield.

3. For the left-hand exhaust manifold, remove the EGR valve-to-exhaust manifold tube and the DPFE transducer hoses.

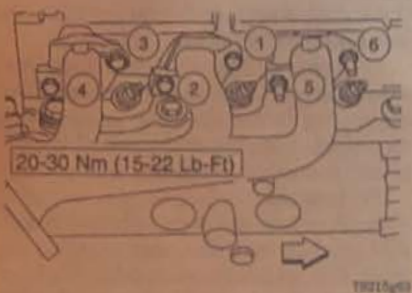
4. Remove the catalytic converter-to-exhaust manifold bolts.

5. Remove the exhaust manifold mounting bolts, then remove the exhaust manifold itself.

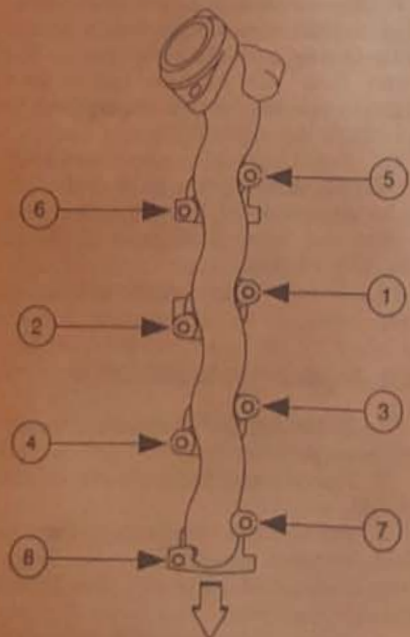
6. Remove and discard the old gasket.



Tighten the left-hand exhaust manifold bolts in the order shown — 4.2L (VIN 2) engines



Tighten the right-hand exhaust manifold bolts in the order shown — 4.2L (VIN 2) engines



Tighten the exhaust manifold bolts in the sequence shown — 4.6L engines (VIN W and VIN 6)

7. Clean and inspect the exhaust manifold for damage.

To install:

8. Position a new gasket and the exhaust manifold onto the engine block. Install the mounting bolts and tighten, in the sequence shown, to 13-16 ft. lbs. (18-22 Nm).

9. Attach the catalytic converter to the exhaust manifold, then install the catalytic converter-to-exhaust manifold bolts and tighten to 25-34 ft. lbs. (34-46 Nm).

10. For the left-hand exhaust manifold, install the DPFE transducer hoses and the EGR valve-to-exhaust manifold tube. Tighten the upper and lower fittings to 28-33 ft. lbs. (35-45 Nm).

11. Install the front fender splash shield.

12. Lower the vehicle to the ground.

5.0L (VIN N), 5.8L (VIN H and R) and 7.5L (VIN G) Engines

1. On the 5.0L (VIN N) engine, remove the dipstick bracket.

2. Disconnect the exhaust pipe or catalytic converter from the exhaust manifold. Remove and discard the doughnut gasket.

3. Remove the exhaust manifold attaching screws and remove the manifold from the cylinder head.

To install:

4. Apply a light coat of graphite grease to the mating surface of the manifold. Install and tighten the attaching bolts, starting from the center and working to both ends alternately. Tighten to the proper specifications.

5. Install the exhaust pipe or catalytic converter to the exhaust manifold using a new doughnut gasket.

6. If necessary, install the dipstick bracket.

Combination Manifold

REMOVAL AND INSTALLATION

4.9L (VIN Y and Z) Engine

NOTE: The lower intake and exhaust manifolds on these engines are known as combination manifolds and are serviced as a unit.

1. Remove the air inlet hose at the crankcase filter cap.

2. Remove the throttle body inlet hoses.

3. Disconnect the accelerator cable at the throttle body.

4. Remove the cable retracting spring.

5. Remove the cable bracket from the upper intake manifold.

6. Disconnect the fuel inlet line at the fuel rail. Don't kink the line!

7. Remove the upper intake and throttle body as an assembly.

8. Tag and disconnect all vacuum lines attached to the parts in question.

9. Disconnect the inlet pipe from the exhaust manifold.

10. Disconnect the power brake vacuum line, if equipped.

11. Remove the bolts and nuts attaching the manifolds to the cylinder head. Lift the manifold assemblies from the engine. Remove and discard the gaskets.

12. To separate the manifold, remove the nuts joining the intake and exhaust manifolds.

To install:

13. Clean the mating surfaces of the cylinder head and the manifolds.

14. If the intake and exhaust manifolds have been separated, coat the mating surfaces lightly with graphite grease and place the exhaust manifold over the studs on the intake manifold. Install the lockwashers and nuts. Tighten them finger tight.

15. Install a new intake manifold gasket.

16. Coat the mating surfaces lightly with graphite grease. Place the manifold assemblies in position against the cylinder head. Make sure the gaskets have not become dislodged. Install the attaching nuts and bolts in the proper sequence to 26 ft. lbs. (35 Nm). If the intake and exhaust manifolds were separated, tighten the nuts joining them.

17. Position a new gasket on the muffler inlet pipe and connect the inlet pipe to the exhaust manifold.

18. Connect the crankcase vent hose to the intake manifold inlet tube and position the hose clamp.

19. Connect the power brake vacuum line, if equipped.

20. Connect the inlet pipe at the exhaust manifold.

21. Connect all vacuum lines.

22. Install the upper intake and throttle body as an assembly.

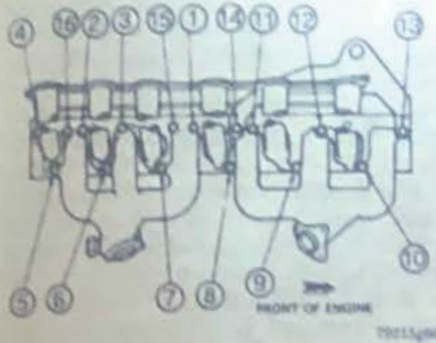
23. Connect the fuel inlet line at the fuel rail.

24. Install the accelerator cable bracket at the upper intake manifold.

25. Install the cable retracting spring.

26. Connect the accelerator cable at the throttle body.

27. Install the throttle body inlet hoses.



Combination manifold bolt torque sequence —
4.0L (VIN Y and Z) engine

25. Install the air inlet hose at the crankcase filter cap.

Front Cover Seal

REMOVAL AND INSTALLATION

4.0L (VIN Z) Engine

NOTE: To correctly perform the following procedure special tools will be needed. These tools are the Crankshaft Damper Remover T58P-6316-D, the Front Seal Installer/Cover Aligner T88T-6701-A, the Vibration Damper Remover Adapter T82L-6316-B, Seal Remover T74P-6700-CH and the Front Seal Replacer T94P-6701-AH (or their equivalents).

1. Remove the accessory drive belt.
2. Remove the fan blade assembly.
3. Raise and safely support the vehicle on jackstands.

NOTE: Matchmark the crankshaft pulley and damper with each other for installation.

4. Loosen the crankshaft damper bolt, then remove the four crankshaft pulley bolts. Remove the pulley.
5. Remove the crankshaft damper bolt, then attach the crankshaft damper remover tool, T58P-6316-D or equivalent, with 2 crankshaft pulley bolts. Turn the vibration damper remover adapter, T82L-6316-B or equivalent, to pull the damper off of the crankshaft.
6. Use seal remover tool, T74P-6700-CH or equivalent, to remove the oil seal from the front cover. Discard the old seal.

To install:

7. Inspect the crankshaft damper and engine front cover for damage

that may cause the front oil seal to fail.

NOTE: Lubricate the parts with clean engine oil before assembly.

8. Use the front seal replacer T94P-6701-AH (spacer), the front seal installer/cover aligner T88T-6701-A and the vibration damper remover adapter T82L-6316-B, or their equivalents, to press the new oil seal into the recess in the front cover.

9. Apply a bead of sealant to the keyway in the crankshaft damper and use the vibration damper remover adapter to install the damper onto the crankshaft. Make sure to utilize Silicone Gasket and Sealant F6AZ-19562-A or equivalent.

10. Install the crankshaft damper bolt and tighten to 103-117 ft. lbs. (140-160 Nm).

NOTE: The crankshaft pulley position on the crankshaft damper was marked before removal, return it to the same position.

11. Install the crankshaft pulley and tighten the 4 pulley mounting bolts to 20-28 ft. lbs. (26-38 Nm)
12. Lower the vehicle.
13. Install the fan blade assembly.
14. Install the accessory drive belt.

4.6L Engines (VIN W and VIN 6)

NOTE: To correctly perform the following procedure special tools will be needed. These tools are the Crankshaft Damper Remover T58P-6316-D, the Front Seal Installer/Cover Aligner T88T-6701-A, the Vibration Damper Replacer T74P-6316-B, and the Seal Remover T74P-6700-A (or their equivalents).

1. Remove the accessory drive belt.
2. Remove the fan blade assembly and fan shroud.
3. Raise and safely support the vehicle on jackstands.
4. Remove the crankshaft pulley bolt.
5. Use the crankshaft damper remover tool, T58P-6316-D or equivalent, to remove the crankshaft pulley.
6. Use seal remover tool, T74P-6700-A or equivalent, to remove the oil seal from the front cover. Discard the old seal.

To install:

7. Inspect the crankshaft damper and engine front cover for damage

that may cause the front oil seal to fail.

NOTE: Lubricate the parts with clean engine oil before assembly.

8. Use the front seal installer/cover aligner T88T-6701-A, or the equivalent, to press the new oil seal into the recess in the front cover.

9. Apply a bead of sealant to the keyway in the crankshaft damper and use the vibration damper remover adapter to install the damper onto the crankshaft. Make sure to utilize Silicone Gasket and Sealant F6AZ-19562-A or equivalent.

10. Use the crankshaft damper replacer tool, T74P-6316-B or equivalent, to install the crankshaft pulley.

11. Loosely install the crankshaft pulley bolt.

NOTE: Make certain to tighten the crankshaft pulley bolt in 4 steps.

12. Install the pulley bolt in 4 steps. Some of the steps require tightening, some require loosening of the bolt. Pay close attention, as follows:

- a. Step 1: tighten to 88 ft. lbs. (120 Nm).
- b. Step 2: loosen the bolt one full revolution (360 degrees).
- c. Step 3: tighten to 34-39 ft. lbs. (47-53 Nm).
- d. Step 4: tighten an additional 85-90 degrees (approximately 1/4 turn).

13. Lower the vehicle.

14. Install the fan blade assembly and fan shroud.

15. Install the accessory drive belt.

4.9L (VIN Y and Z) Engine

1. Drain the cooling system and disconnect the radiator upper hose at the coolant outlet elbow and remove the 2 upper radiator retaining bolts.

2. Raise the vehicle and drain the crankcase.

3. Remove the splash shield and the automatic transmission oil cooling lines, if equipped, then remove the radiator.

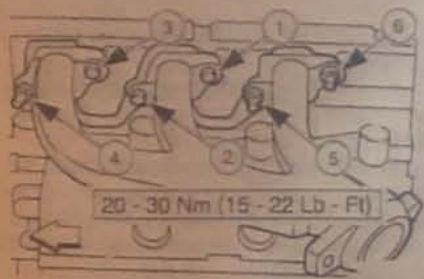
4. Loosen and remove the fan belt, fan and pulley.

5. Use a gear puller to remove the crankshaft pulley damper.

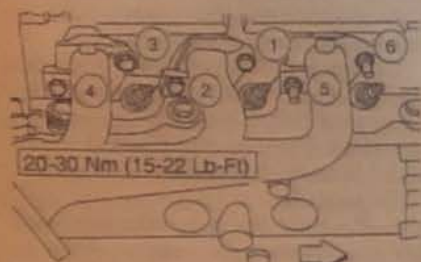
6. Remove the cylinder front cover retaining bolts and gently pry the cover away from the block. Remove the gasket.

7. Drive out the old seal with a pin punch from the rear of the cover. Clean out the recess in the cover.

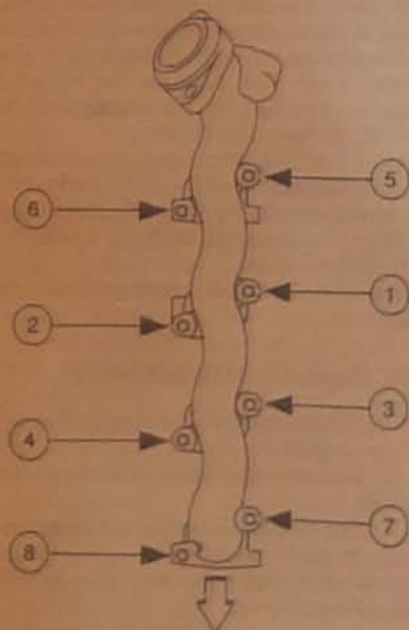
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Tighten the left-hand exhaust manifold bolts in the order shown — 4.2L (VIN 2) engines



Tighten the right-hand exhaust manifold bolts in the order shown — 4.2L (VIN 2) engines



Tighten the exhaust manifold bolts in the sequence shown — 4.6L engines (VIN W and VIN 6)

7. Clean and inspect the exhaust manifold for damage.

To install:

8. Position a new gasket and the exhaust manifold onto the engine block. Install the mounting bolts and tighten, in the sequence shown, to 13-16 ft. lbs. (18-22 Nm).

9. Attach the catalytic converter to the exhaust manifold, then install the catalytic converter-to-exhaust manifold bolts and tighten to 25-34 ft. lbs. (34-46 Nm).

10. For the left-hand exhaust manifold, install the DPFE transducer hoses and the EGR valve-to-exhaust manifold tube. Tighten the upper and lower fittings to 26-33 ft. lbs. (35-45 Nm).

11. Install the front fender splash shield.

12. Lower the vehicle to the ground.

5.0L (VIN N), 5.8L (VIN H and R) and 7.5L (VIN G) Engines

1. On the 5.0L (VIN N) engine, remove the dipstick bracket.

2. Disconnect the exhaust pipe or catalytic converter from the exhaust manifold. Remove and discard the doughnut gasket.

3. Remove the exhaust manifold attaching screws and remove the manifold from the cylinder head.

To install:

4. Apply a light coat of graphite grease to the mating surface of the manifold. Install and tighten the attaching bolts, starting from the center and working to both ends alternately. Tighten to the proper specifications.

5. Install the exhaust pipe or catalytic converter to the exhaust manifold using a new doughnut gasket.

6. If necessary, install the dipstick bracket.

Combination Manifold

REMOVAL AND INSTALLATION

4.9L (VIN Y and Z) Engine

NOTE: The lower intake and exhaust manifolds on these engines are known as combination manifolds and are serviced as a unit.

1. Remove the air inlet hose at the crankcase filter cap.

2. Remove the throttle body inlet hoses.

3. Disconnect the accelerator cable at the throttle body.

4. Remove the cable retracting spring.

5. Remove the cable bracket from the upper intake manifold.

6. Disconnect the fuel inlet line at the fuel rail. Don't kink the line!

7. Remove the upper intake and throttle body as an assembly.

8. Tag and disconnect all vacuum lines attached to the parts in question.

9. Disconnect the inlet pipe from the exhaust manifold.

10. Disconnect the power brake vacuum line, if equipped.

11. Remove the bolts and nuts attaching the manifolds to the cylinder head. Lift the manifold assemblies from the engine. Remove and discard the gaskets.

12. To separate the manifold, remove the nuts joining the intake and exhaust manifolds.

To install:

13. Clean the mating surfaces of the cylinder head and the manifolds.

14. If the intake and exhaust manifolds have been separated, coat the mating surfaces lightly with graphite grease and place the exhaust manifold over the studs on the intake manifold. Install the lockwashers and nuts. Tighten them finger tight.

15. Install a new intake manifold gasket.

16. Coat the mating surfaces lightly with graphite grease. Place the manifold assemblies in position against the cylinder head. Make sure the gaskets have not become dislodged. Install the attaching nuts and bolts in the proper sequence to 26 ft. lbs. (35 Nm). If the intake and exhaust manifolds were separated, tighten the nuts joining them.

17. Position a new gasket on the muffler inlet pipe and connect the inlet pipe to the exhaust manifold.

18. Connect the crankcase vent hose to the intake manifold inlet tube and position the hose clamp.

19. Connect the power brake vacuum line, if equipped.

20. Connect the inlet pipe at the exhaust manifold.

21. Connect all vacuum lines.

22. Install the upper intake and throttle body as an assembly.

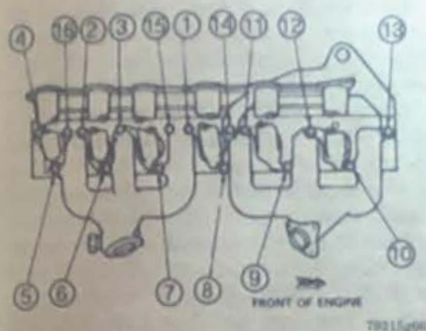
23. Connect the fuel inlet line at the fuel rail.

24. Install the accelerator cable bracket at the upper intake manifold.

25. Install the cable retracting spring.

26. Connect the accelerator cable at the throttle body.

27. Install the throttle body inlet hoses.



Combination manifold bolt torque sequence — 4.9L (VIN Y and Z) engine

28. Install the air inlet hose at the crankcase filter cap.

Front Cover Seal

REMOVAL AND INSTALLATION

4.2L (VIN 2) Engine

NOTE: To correctly perform the following procedure special tools will be needed. These tools are the Crankshaft Damper Remover T58P-6316-D, the Front Seal Installer/Cover Aligner T88T-6701-A, the Vibration Damper Remover Adapter T82L-6316-B, Seal Remover T92C-6700-CH and the Front Seal Replacer T94P-6701-AH (or their equivalents).

1. Remove the accessory drive belt.
2. Remove the fan blade assembly.
3. Raise and safely support the vehicle on jackstands.

NOTE: Matchmark the crankshaft pulley and damper with each other for installation.

4. Loosen the crankshaft damper bolt, then remove the four crankshaft pulley bolts. Remove the pulley.
5. Remove the crankshaft damper bolt, then attach the crankshaft damper remover tool, T58P-6316-D or equivalent, with 2 crankshaft pulley bolts. Turn the vibration damper remover adapter, T82L-6316-B or equivalent, to pull the damper off of the crankshaft.
6. Use seal remover tool, T92C-6700-CH or equivalent, to remove the oil seal from the front cover. Discard the old seal.
- To install:**
7. Inspect the crankshaft damper and engine front cover for damage

that may cause the front oil seal to fail.

NOTE: Lubricate the parts with clean engine oil before assembly.

8. Use the front seal replacer T94P-6701-AH (spacer), the front seal installer/cover aligner T88T-6701-A and the vibration damper remover adapter T82L-6316-B, or their equivalents, to press the new oil seal into the recess in the front cover.

9. Apply a bead of sealant to the keyway in the crankshaft damper and use the vibration damper remover adapter to install the damper onto the crankshaft. Make sure to utilize Silicone Gasket and Sealant F6AZ-19562-A or equivalent.

10. Install the crankshaft damper bolt and tighten to 103-117 ft. lbs. (140-160 Nm).

NOTE: The crankshaft pulley position on the crankshaft damper was marked before removal, return it to the same position.

11. Install the crankshaft pulley and tighten the 4 pulley mounting bolts to 20-28 ft. lbs. (26-38 Nm).
12. Lower the vehicle.
13. Install the fan blade assembly.
14. Install the accessory drive belt.

4.6L Engines (VIN W and VIN 6)

NOTE: To correctly perform the following procedure special tools will be needed. These tools are the Crankshaft Damper Remover T58P-6316-D, the Front Seal Installer/Cover Aligner T88T-6701-A, the Vibration Damper Replacer T74P-6316-B, and the Seal Remover T74P-6700-A (or their equivalents).

1. Remove the accessory drive belt.
2. Remove the fan blade assembly and fan shroud.
3. Raise and safely support the vehicle on jackstands.
4. Remove the crankshaft pulley bolt.
5. Use the crankshaft damper remover tool, T58P-6316-D or equivalent, to remove the crankshaft pulley.
6. Use seal remover tool, T74P-6700-A or equivalent, to remove the oil seal from the front cover. Discard the old seal.
- To install:**
7. Inspect the crankshaft damper and engine front cover for damage

that may cause the front oil seal to fail.

NOTE: Lubricate the parts with clean engine oil before assembly.

8. Use the front seal installer/cover aligner T88T-6701-A, or the equivalent, to press the new oil seal into the recess in the front cover.

9. Apply a bead of sealant to the keyway in the crankshaft damper and use the vibration damper remover adapter to install the damper onto the crankshaft. Make sure to utilize Silicone Gasket and Sealant F6AZ-19562-A or equivalent.

10. Use the crankshaft damper replacer tool, T74P-6316-B or equivalent, to install the crankshaft pulley.

11. Loosely install the crankshaft pulley bolt.

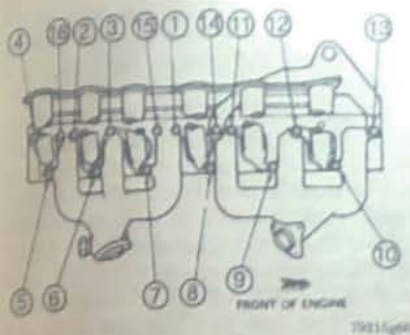
NOTE: Make certain to tighten the crankshaft pulley bolt in 4 steps.

12. Install the pulley bolt in 4 steps. Some of the steps require tightening, some require loosening of the bolt. Pay close attention, as follows:

- a. Step 1: tighten to 88 ft. lbs. (120 Nm).
- b. Step 2: loosen the bolt one full revolution (360 degrees).
- c. Step 3: tighten to 34-39 ft. lbs. (47-53 Nm).
- d. Step 4: tighten an additional 85-90 degrees (approximately 1/4 turn).
13. Lower the vehicle.
14. Install the fan blade assembly and fan shroud.
15. Install the accessory drive belt.

4.9L (VIN Y and Z) Engine

1. Drain the cooling system and disconnect the radiator upper hose at the coolant outlet elbow and remove the 2 upper radiator retaining bolts.
2. Raise the vehicle and drain the crankcase.
3. Remove the splash shield and the automatic transmission oil cooling lines, if equipped, then remove the radiator.
4. Loosen and remove the fan belt fan and pulley.
5. Use a gear puller to remove the crankshaft pulley damper.
6. Remove the cylinder front cover retaining bolts and gently pry the cover away from the block. Remove the gasket.
7. Drive out the old seal with a punch from the rear of the cover. Clean out the recess in the cover.



Combination manifold bolt torque sequence —
4.9L (VIN Y and Z) engine

28. Install the air inlet hose at the crankcase filter cap.

Front Cover Seal

REMOVAL AND INSTALLATION

4.2L (VIN 2) Engine

NOTE: To correctly perform the following procedure special tools will be needed. These tools are the Crankshaft Damper Remover T58P-6316-D, the Front Seal Installer/Cover Aligner T88T-6701-A, the Vibration Damper Remover Adapter T82L-6316-B, Seal Remover T92C-6700-CH and the Front Seal Replacer T94P-6701-AH (or their equivalents).

1. Remove the accessory drive belt.
2. Remove the fan blade assembly.
3. Raise and safely support the vehicle on jackstands.

NOTE: Matchmark the crankshaft pulley and damper with each other for installation.

4. Loosen the crankshaft damper bolt, then remove the four crankshaft pulley bolts. Remove the pulley.
5. Remove the crankshaft damper bolt, then attach the crankshaft damper remover tool, T58P-6316-D or equivalent, with 2 crankshaft pulley bolts. Turn the vibration damper remover adapter, T82L-6316-B or equivalent, to pull the damper off of the crankshaft.

6. Use seal remover tool, T92C-6700-CH or equivalent, to remove the oil seal from the front cover. Discard the old seal.

To install:

7. Inspect the crankshaft damper and engine front cover for damage

that may cause the front oil seal to fail.

NOTE: Lubricate the parts with clean engine oil before assembly.

8. Use the front seal replacer T94P-6701-AH (spacer), the front seal installer/cover aligner T88T-6701-A and the vibration damper remover adapter T82L-6316-B, or their equivalents, to press the new oil seal into the recess in the front cover.

9. Apply a bead of sealant to the keyway in the crankshaft damper and use the vibration damper remover adapter to install the damper onto the crankshaft. Make sure to utilize Silicone Gasket and Sealant F6AZ-19562-A or equivalent.

10. Install the crankshaft damper bolt and tighten to 103-117 ft. lbs. (140-160 Nm).

NOTE: The crankshaft pulley position on the crankshaft damper was marked before removal, return it to the same position.

11. Install the crankshaft pulley and tighten the 4 pulley mounting bolts to 20-28 ft. lbs. (26-38 Nm).
12. Lower the vehicle.
13. Install the fan blade assembly.
14. Install the accessory drive belt.

4.6L Engines (VIN W and VIN 6)

NOTE: To correctly perform the following procedure special tools will be needed. These tools are the Crankshaft Damper Remover T58P-6316-D, the Front Seal Installer/Cover Aligner T88T-6701-A, the Vibration Damper Replacer T74P-6316-B, and the Seal Remover T74P-6700-A (or their equivalents).

1. Remove the accessory drive belt.
2. Remove the fan blade assembly and fan shroud.
3. Raise and safely support the vehicle on jackstands.
4. Remove the crankshaft pulley bolt.
5. Use the crankshaft damper remover tool, T58P-6316-D or equivalent, to remove the crankshaft pulley.

6. Use seal remover tool, T74P-6700-A or equivalent, to remove the oil seal from the front cover. Discard the old seal.

To install:

7. Inspect the crankshaft damper and engine front cover for damage

that may cause the front oil seal to fail.

NOTE: Lubricate the parts with clean engine oil before assembly.

8. Use the front seal installer/cover aligner T88T-6701-A, or the equivalent, to press the new oil seal into the recess in the front cover.

9. Apply a bead of sealant to the keyway in the crankshaft damper and use the vibration damper remover adapter to install the damper onto the crankshaft. Make sure to utilize Silicone Gasket and Sealant F6AZ-19562-A or equivalent.

10. Use the crankshaft damper replacer tool, T74P-6316-B or equivalent, to install the crankshaft pulley.

11. Loosely install the crankshaft pulley bolt.

NOTE: Make certain to tighten the crankshaft pulley bolt in 4 steps.

12. Install the pulley bolt in 4 steps. Some of the steps require tightening, some require loosening of the bolt. Pay close attention, as follows:

- a. Step 1: tighten to 88 ft. lbs. (120 Nm).
- b. Step 2: loosen the bolt one full revolution (360 degrees).
- c. Step 3: tighten to 34-39 ft. lbs. (47-53 Nm).
- d. Step 4: tighten an additional 85-90 degrees (approximately 1/4 turn).

13. Lower the vehicle.
14. Install the fan blade assembly and fan shroud.
15. Install the accessory drive belt.

4.9L (VIN Y and Z) Engine

1. Drain the cooling system and disconnect the radiator upper hose at the coolant outlet elbow and remove the 2 upper radiator retaining bolts.

2. Raise the vehicle and drain the crankcase.

3. Remove the splash shield and the automatic transmission oil cooling lines, if equipped, then remove the radiator.

4. Loosen and remove the fan belt, fan and pulley.

5. Use a gear puller to remove the crankshaft pulley damper.

6. Remove the cylinder front cover retaining bolts and gently pry the cover away from the block. Remove the gasket.

7. Drive out the old seal with a pin punch from the rear of the cover. Clean out the recess in the cover.

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6. Repeat the rotation/checking procedure for the remaining valves in firing order, that is: 6-2-4.

5.0L (VIN N) Engine

1. Rotate the crankshaft by hand so No. 1 piston is at TDC of the compression stroke. Make a chalk mark on the damper at that point, then, make 2 more chalk marks about 90 degrees apart in a clockwise direction.

2. With No. 1 at TDC, slowly apply pressure, using Lifter Bleed-down wrench T70P-6513-A, or equivalent, to completely bottom the lifter, on the following valves:

- No. 1 intake and exhaust
- No. 7 intake
- No. 5 exhaust
- No. 8 intake
- No. 4 exhaust

Take care to avoid excessive pressure that might bend the pushrod. Hold the lifter in this position and check the clearance between the rocker arm and the valve stem tip. Allowable clearance is 0.071-0.193 in. (1.8-4.9mm) with a desired clearance of 0.096-0.165 in. (2.4-4.2mm).

3. If the clearance is less than specified, install a shorter pushrod. If the clearance is greater than specified, install a longer pushrod.

4. Rotate the crankshaft clockwise — viewed from the front — 180 degrees, until the next chalk mark is aligned with the timing pointer. Repeat the procedure for:

- No. 5 intake
- No. 2 exhaust
- No. 4 intake
- No. 6 exhaust



Valve clearance adjustment positions on the crankshaft damper — 4.9L (VIN Y and Z) engine

5. Rotate the crankshaft to the next chalk mark — 90 degrees — and repeat the procedure for:

- No. 2 intake
- No. 7 exhaust
- No. 3 intake and exhaust
- No. 6 intake
- No. 8 exhaust

5.0L (VIN H and R) Engine

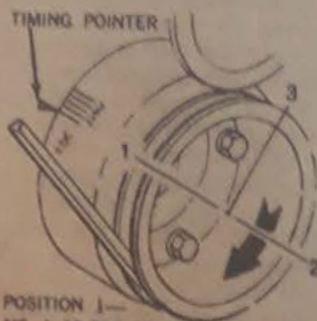
1. Rotate the crankshaft by hand so No. 1 piston is at TDC of the compression stroke. Make a chalk mark on the damper at that point, then, make 2 more chalk marks about 90 degrees apart in a clockwise direction.

2. With No. 1 at TDC, slowly apply pressure, using Lifter Bleed-down wrench T70P-6513-A, or equivalent, to completely bottom the lifter, on the following valves:

- No. 1 intake and exhaust
- No. 4 intake
- No. 3 exhaust
- No. 8 intake
- No. 7 exhaust

Take care to avoid excessive pressure that might bend the pushrod. Hold the lifter in this position and check the clearance between the

WITH NO. 1 AT TDC AT THE END OF THE COMPRESSION STROKE MAKE A CHALK MARK AT POINTS 2 AND 3 APPROXIMATELY 90 DEGREES APART.



POSITION 1 — NO. 1 AT TDC AT THE END OF THE COMPRESSION STROKE

POSITION 2 — ROTATE THE CRANKSHAFT 180 DEGREES (ONE HALF REVOLUTION) CLOCKWISE FROM POSITION 1

POSITION 3 — ROTATE THE CRANKSHAFT 270 DEGREES (THREE QUARTER REVOLUTION) CLOCKWISE FROM POSITION 2

Valve clearance adjustment positions on the crankshaft damper/pulley — 5.0L (VIN N), 5.9L (VIN H and R) and 7.5L (VIN G) engines

rocker arm and the valve stem tip. Allowable clearance is 0.098-0.198 in. (2.5-5.0mm) with a desired clearance of 0.123-0.173 in. (3.1-4.4mm).

3. If the clearance is less than specified, install a shorter pushrod. If the clearance is greater than specified, install a longer pushrod.

4. Rotate the crankshaft clockwise — viewed from the front — 180 degrees, until the next chalk mark is aligned with the timing pointer. Repeat the procedure for:

- No. 3 intake
- No. 2 exhaust
- No. 7 intake
- No. 6 exhaust

5. Rotate the crankshaft to the next chalk mark — 90 degrees — and repeat the procedure for:

- No. 2 intake
- No. 4 exhaust
- No. 5 intake and exhaust
- No. 6 intake
- No. 8 exhaust

7.5L (VIN G) Engine

1. Rotate the crankshaft by hand so No. 1 piston is at TDC of the compression stroke. Make a chalk mark on the damper at that point.

2. With No. 1 at TDC, slowly apply pressure, using Lifter Bleed-down wrench T70P-6513-A, or equivalent, to completely bottom the lifter, on the following valves:

- No. 1 intake and exhaust
- No. 3 intake
- No. 4 exhaust
- No. 7 intake
- No. 5 exhaust
- No. 8 intake and exhaust

Take care to avoid excessive pressure that might bend the pushrod. Hold the lifter in this position and check the clearance between the rocker arm and the valve stem tip. Allowable clearance is 0.075-0.175 in. (1.9-4.4mm) with a desired clearance of 0.100-0.150 in. (2.5-3.8mm).

3. If the clearance is less than specified, install a shorter pushrod. If the clearance is greater than specified, install a longer pushrod.

4. Rotate the crankshaft clockwise — viewed from the front — 360 degrees, until the chalk mark is once again aligned with the timing pointer. Repeat the procedure for:

- No. 2 intake and exhaust
- No. 4 intake
- No. 3 exhaust
- No. 5 intake
- No. 7 exhaust
- No. 6 intake and exhaust

To install:

8. Coat the new seal with grease and drive it into the cover until it is fully seated. Check the seal to make sure the spring around the seal is in the proper position.

9. Clean the cylinder front cover and the gasket surface of the cylinder block. Apply an oil-resistant sealer to the new front cover gasket and install the gasket onto the cover.

10. Position the front cover assembly over the end of the crankshaft and against the cylinder block. Start, but do not tighten, the cover and pan attaching screws. Slide a front cover alignment tool (Ford part no. T68P-6019-A or equivalent) over the crank stub and into the seal bore of the cover. Tighten all front cover attaching screws to 12-18 ft. lbs. (16-24 Nm) and all oil pan attaching screws to 10-15 ft. lbs. (14-20 Nm). Tighten the oil pan screws first.

NOTE: Trim away the exposed portion of the old oil pan gasket flush with the front of the engine block. Cut and position the required portion of a new gasket to the oil pan and apply sealer to both sides.

11. Lubricate the hub of the crankshaft damper pulley with Lubriplate® to prevent damage to the seal during installation or on initial starting of the engine.

12. Install the fan belt, fan and pulley.

13. Install the radiator.

14. Install the splash shield and the automatic transmission oil cooling lines, if equipped.

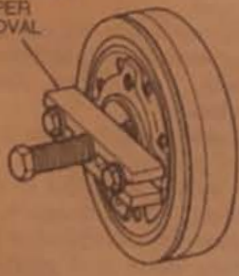
15. Fill the crankcase.

16. Connect the radiator upper hose at the coolant outlet elbow and install the 2 upper radiator retaining bolts.

17. Drain the cooling system.

18. Start the engine and check for leaks.

CRANKSHAFT DAMPER REMOVAL



Crankshaft damper removal — 4.9L (VIN Y and Z), 5.0L (VIN N), 5.8L (VIN H and R) and 7.5L (VIN G) engines



Crankshaft damper installation — 4.9L (VIN Y and Z), 5.0L (VIN N), 5.8L (VIN H and R) and 7.5L (VIN G) engines

5.0L (VIN N) and 5.8L (VIN H and R) Engines

1. Drain the cooling system and the crankcase.

2. Disconnect the upper and lower radiator hoses from the water pump, transmission oil cooler lines from the radiator, and remove the radiator.

3. Disconnect the heater hose from the water pump. Slide the water pump by-pass hose clamp toward the water pump.

4. Loosen the alternator pivot bolt and the bolt which secures the alternator adjusting arm to the water pump. Position the alternator out of the way.

5. Remove the power steering pump and air conditioning compressor from their mounting brackets, if equipped.

6. Remove the bolts holding the fan shroud to the radiator, if equipped. Remove the fan, spacer, pulley and drive belts.

7. Remove the crankshaft pulley from the crankshaft damper. Remove the damper attaching bolt and washer and remove the damper with a puller.

8. Disconnect the fuel pump outlet line at the fuel pump. Disconnect the vacuum inlet and outlet lines from the fuel pump. Remove the fuel pump attaching bolts and lay the pump to one side with the fuel inlet line still attached.

9. Remove the oil level dipstick and the bolt holding the dipstick tube to the exhaust manifold on the 5.0L (VIN N) engine.

10. Remove the oil pan-to-cylinder front cover attaching bolts. Use a sharp, thin cutting blade to cut the oil pan gasket flush with the cylinder block. Remove the front cover and water pump as an assembly.

11. Discard the front cover gasket.

To install:

12. Place the front seal removing tool (Ford part no. T70P-6B070-A or

equivalent) into the front cover plate and over the front of the seal. Tighten the 2 through bolts to force the seal puller under the seal flange, then alternately tighten the 4 puller bolts a half turn at a time to pull the oil seal from the cover.

13. Coat a new front cover oil seal with Lubriplate® or equivalent and place it onto the front oil seal alignment and installation tool (Ford part no. T70P-6B070-A or equivalent). Place the tool and the seal onto the end of the crankshaft and push it toward the engine until the seal starts into the front cover.

14. Place the installation screw, washer, and nut onto the end of the crankshaft, then thread the screw into the crankshaft. Tighten the nut against the washer and tool to force the seal into the front cover plate. Remove the tool.

15. Apply Lubriplate® or equivalent to the oil seal rubbing surface of the vibration damper inner hub to prevent damage to the seal. Coat the front of the crankshaft with oil for damper installation.

16. To install the damper, line up the damper keyway with the key on the crankshaft, then install the damper onto the crankshaft. Install the cap screw and washer, and tighten the screw to 80 ft. lbs. (109 Nm). Install the crankshaft pulley.

17. Install the fan, spacer, pulley and drive belts.

18. Install the bolts holding the fan shroud to the radiator, if equipped.

19. Install the power steering pump and air conditioning compressor.

20. Position and tighten the alternator.

21. Connect the heater hose at the water pump.

22. Install the radiator.

23. Connect the upper and lower radiator hoses, and transmission oil cooler lines.

24. Fill the cooling system and the crankcase.

7.5L (VIN G) Engine

1. Drain the cooling system and crankcase.

2. Remove the radiator shroud and fan.

3. Disconnect the upper and lower radiator hoses, and the automatic transmission oil cooler lines from the radiator.

4. Remove the radiator upper support and remove the radiator.

5. Loosen the alternator attaching bolts and air conditioning compressor idler pulley and remove the drive belts with the water pump pulley. Re-

remove the bolts attaching the compressor support to the water pump and remove the bracket (support), if equipped.

8. Remove the crankshaft pulley from the vibration damper. Remove the bolt and washer attaching the crankshaft damper and remove the damper with a puller. Remove the woodruff key from the crankshaft.

9. Loosen the by-pass hose at the water pump, and disconnect the heater return tube at the water pump.

10. Disconnect and plug the fuel inlet and outlet lines at the fuel pump, and remove the fuel pump.

11. Remove the bolts attaching the front cover to the cylinder block. Cut the oil pan seal flush with the cylinder block face with a thin knife blade prior to separating the cover from the cylinder block. Remove the cover and water pump as an assembly. Discard the front cover gasket and oil pan seal.

To install:

12. Transfer the water pump if a new cover is going to be installed. Clean all of the gasket sealing surfaces on both the front cover and the cylinder block.

13. Coat the gasket surface of the oil pan with sealer. Cut and position the required sections of a new seal on the oil pan. Apply sealer to the grooves.

14. Drive out the old front cover oil seal with a putty knife. Clean out the seal recess in the cover; coat a new seal with lubricant or equivalent grease. Install the seal, making sure the seal spring remains in the proper position. A front cover seal tool, Ford part no. T700-127 or equivalent, makes installation easier.

15. Coat the gasket surfaces of the cylinder block and cover with sealer and position the new gasket on the block.

16. Position the front cover on the cylinder block. Use care not to damage the seal and gasket or misplace them.

17. Coat the front cover attaching screws with sealer and install them.

NOTE: It may be necessary to force the front cover downward to compress the oil pan seal in order to install the front cover attaching bolts. Use a prybar or stiff bar to engage the cover screw holes through the cover and pry downward.

18. Install the fuel pump.

19. Connect the fuel inlet and outlet lines at the fuel pump.

20. Tighten the by-pass hose at the water pump.

21. Connect the heater return tube at the water pump.

22. Install the woodruff key from the crankshaft.

23. Install the damper.

24. Install the crankshaft pulley on the vibration damper.

25. Install the compressor support on the water pump and install the bracket (support), if equipped.

26. Install the drive belts with the water pump pulley.

27. Install the radiator and upper support.

28. Connect the upper and lower radiator hoses, and the automatic transmission oil cooler lines.

29. Install the radiator shroud and fan.

30. Fill the cooling system and crankcase.

Observe the following torques:

- Front cover bolts—15-20 ft. lbs. (20-27 Nm)

- Water pump attaching screws—13-15 ft. lbs. (16-20 Nm)

- Crankshaft damper—70-80 ft. lbs. (95-112 Nm)

- Crankshaft pulley—35-50 ft. lbs. (48-68 Nm)

- Fuel pump—15-27 ft. lbs. (20-37 Nm)

- Oil pan bolts—9-11 ft. lbs. (12.2-15.0 Nm) for the 3/8 in. (9.5mm) screws and to 7-9 ft. lbs. (9.5-12.2 Nm) for the 1/2 in. (12.7mm) screws

- Alternator pivot bolt—45-57 ft. lbs. (61-77 Nm)

Timing Chain, Sprockets and Front Cover

REMOVAL AND INSTALLATION

4.2L (VIN 2) Engine

NOTE: Along with the special tools required to remove the crankshaft pulley and damper, a Synchronizer Positioning Tool, such as Ford Tool T89p-12390-A, must be obtained prior to installation of the replacement synchronizer assembly. Failure to follow this procedure will result in the fuel system being out of time with the engine, possible causing engine damage.

1. Disconnect the negative battery cable.

2. Remove the radiator, fan blade assembly and fan shroud.

3. Remove the water pump.

4. Remove the camshaft synchronizer as follows:

a. Remove the EGR valve vacuum hose.

b. Remove the EGR tube upper fitting, then remove the EGR valve and adapter.

c. Disconnect the heater water outlet tube.

d. Remove the Camshaft Position (CMP) sensor connector and mark the orientation of the CMP connector (the direction it is pointing).

WARNING

Unless explicitly told to do so in the instructions, do not turn the crankshaft or camshaft after removing the CMP and camshaft synchronizer or the fuel system timing will be out of time with the engine and possible cause engine damage.

e. Rotate the crankshaft until the TDC mark lines up with the timing mark.

f. Remove the 2 hold-down bolts, then remove the CMP from the camshaft synchronizer.

g. Remove the camshaft synchronizer adjustment bolt, then remove the camshaft synchronizer. The oil pump driveshaft may come out with the synchronizer.

5. Remove the crankshaft pulley and damper.

6. Remove the oil pan.

WARNING

The cap screw is hidden, make sure to remove or the front cover will be damaged.

7. Remove the all of the front cover retainers (2 stud bolts, 1 bolt, 1 cap screw). The cap screw is located on the bottom edge of the cover, near the oil filter mounting flange.

8. Slide the front cover and gasket off of the dowels. Discard the gasket.

9. Remove the camshaft position sensor drive gear.

10. Rotate the crankshaft until the timing marks (A) and keyways (B) are aligned.

11. Compress the timing chain tensioner, then install a retaining pin to hold in place.

12. Remove the camshaft sprocket, the crankshaft sprocket and the timing chain as an assembly.

13. Remove the timing chain tensioner.

To install:

14. Position the timing chain tensioner in place in the engine, then

move the bolts attaching the compressor support to the water pump and remove the bracket (support), if equipped.

6. Remove the crankshaft pulley from the vibration damper. Remove the bolt and washer attaching the crankshaft damper and remove the damper with a puller. Remove the woodruff key from the crankshaft.

7. Loosen the by-pass hose at the water pump, and disconnect the heater return tube at the water pump.

8. Disconnect and plug the fuel inlet and outlet lines at the fuel pump, and remove the fuel pump.

9. Remove the bolts attaching the front cover to the cylinder block. Cut the oil pan seal flush with the cylinder block face with a thin knife blade prior to separating the cover from the cylinder block. Remove the cover and water pump as an assembly. Discard the front cover gasket and oil pan seal.

To install:

10. Transfer the water pump if a new cover is going to be installed. Clean all of the gasket sealing surfaces on both the front cover and the cylinder block.

11. Coat the gasket surface of the oil pan with sealer. Cut and position the required sections of a new seal on the oil pan. Apply sealer to the corners.

12. Drive out the old front cover oil seal with a pin punch. Clean out the seal recess in the cover, coat a new seal with Lubriplate® or equivalent grease. Install the seal, making sure the seal spring remains in the proper position. A front cover seal tool, Ford part no. T72J-117 or equivalent, makes installation easier.

13. Coat the gasket surfaces of the cylinder block and cover with sealer and position the new gasket on the block.

14. Position the front cover on the cylinder block. Use care not to damage the seal and gasket or misplace them.

15. Coat the front cover attaching screws with sealer and install them.

NOTE: It may be necessary to force the front cover downward to compress the oil pan seal in order to install the front cover attaching bolts. Use a prybar or drift to engage the cover screw holes through the cover and pry downward.

16. Install the fuel pump.

17. Connect the fuel inlet and outlet lines at the fuel pump.

18. Tighten the by-pass hose at the water pump.

19. Connect the heater return tube at the water pump.

20. Install the woodruff key from the crankshaft.

21. Install the damper.

22. Install the crankshaft pulley on the vibration damper.

23. Install the compressor support on the water pump and install the bracket (support), if equipped.

24. Install the drive belts with the water pump pulley.

25. Install the radiator and upper support.

26. Connect the upper and lower radiator hoses, and the automatic transmission oil cooler lines.

27. Install the radiator shroud and fan.

28. Fill the cooling system and crankcase.

Observe the following torques:

- Front cover bolts — 15-20 ft. lbs. (20-27 Nm)

- Water pump attaching screws — 12-15 ft. lbs. (16-20 Nm)

- Crankshaft damper — 70-90 ft. lbs. (95-122 Nm)

- Crankshaft pulley — 35-50 ft. lbs. (48-68 Nm)

- Fuel pump — 19-27 ft. lbs. (26-37 Nm)

- Oil pan bolts — 9-11 ft. lbs. (12.2-15.0 Nm) for the 7/16 in. (7.9mm) screws and to 7-9 ft. lbs. (9.5-12.2 Nm) for the 1/4 in. (6.3mm) screws

- Alternator pivot bolt — 45-57 ft. lbs. (61-77 Nm)

Timing Chain, Sprockets and Front Cover

REMOVAL AND INSTALLATION

4.2L (VIN 2) Engine

NOTE: Along with the special tools required to remove the crankshaft pulley and damper, a Synchron Positioning Tool, such as Ford Tool T89p-12200-A, must be obtained prior to installation of the replacement synchronizer assembly. Failure to follow this procedure will result in the fuel system being out of time with the engine, possible causing engine damage.

1. Disconnect the negative battery cable.

2. Remove the radiator, fan blade assembly and fan shroud.

3. Remove the water pump.

4. Remove the camshaft synchronizer as follows:

- a. Remove the EGR valve vacuum hose.

- b. Remove the EGR tube upper fitting, then remove the EGR valve and adapter.

- c. Disconnect the heater water outlet tube.

- d. Remove the Camshaft Position (CMP) sensor connector and mark the orientation of the CMP connector (the direction it is pointing).

WARNING

Unless explicitly told to do so in the instructions, do not turn the crankshaft or camshaft after removing the CMP and camshaft synchronizer or the fuel system timing will be out of time with the engine and possible cause engine damage.

- e. Rotate the crankshaft until the TDC mark lines up with the timing mark.

- f. Remove the 2 hold-down bolts, then remove the CMP from the camshaft synchronizer.

- g. Remove the camshaft synchronizer adjustment bolt, then remove the camshaft synchronizer. The oil pump driveshaft may come out with the synchronizer.

5. Remove the crankshaft pulley and damper.

6. Remove the oil pan.

WARNING

The cap screw is hidden, make sure to remove or the front cover will be damaged.

7. Remove the all of the front cover retainers (2 stud bolts, 1 bolt, 1 cap screw). The cap screw is located on the bottom edge of the cover, near the oil filter mounting flange.

8. Slide the front cover and gasket off of the dowels. Discard the gasket.

9. Remove the camshaft position sensor drive gear.

10. Rotate the crankshaft until the timing marks (A) and keyways (B) are aligned.

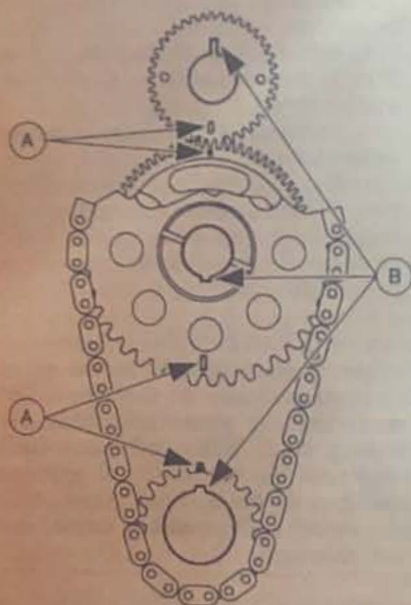
11. Compress the timing chain tensioner, then install a retaining pin to hold in place.

12. Remove the camshaft sprocket, the crankshaft sprocket and the timing chain as an assembly.

13. Remove the timing chain tensioner.

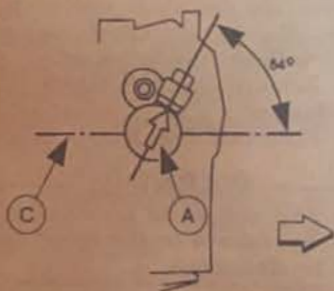
To install:

14. Position the timing chain tensioner in place on the engine, then



T9214a73

After removing the CMP drive gear, align the timing marks (A) and keyways (B) — 4.2L (VIN 2) engines



T9215g74

Install the camshaft synchronizer in the orientation shown (arrow points to front of engine) — 4.2L (VIN 2) engines

install the 3 retaining bolts to 6–10 ft. lbs. (8–14 Nm).

15. Rotate the crankshaft so that No. 1 piston is at Top Dead Center (TDC) and the crankshaft key is in the 12 o'clock position; this should have already been done during removal.

16. If necessary, retract the tensioner pad mechanism. Use a retaining pin to hold the retracted pad in position.

17. Turn the inner, smaller camshaft sprocket so that the timing mark is on the bottom.

18. Install the timing chain, camshaft outer sprocket and the crankshaft sprocket as an assembly.

19. Make sure that the timing marks (A) and the keyways (B) are aligned as during removal.

20. Position the CMP drive gear onto the camshaft stub, then install the retaining bolt to 30–36 ft. lbs. (40–50 Nm).

21. Remove the timing chain tensioner retaining pin.

22. Clean the front cover and engine block mounting surfaces of dirt, grease or old gasket material. Install the front cover onto the engine dowel pins along with a new gasket. Tighten the 4 front cover fasteners to 15–22 ft. lbs. (20–30 Nm).

23. Install the oil pan.

24. Install the crankshaft pulley and damper.

25. Install the synchro positioning tool on the camshaft synchronizer by rotating the synchro p

NOTE: During installation, the arrow on the synchronizer alignment tool will rotate clockwise as the gears engage.

26. Install the camshaft synchronizer housing assembly so that the arrow on the synchronizer alignment tool points forward and up 54 degrees from the centerline of the engine block.

27. Install the camshaft synchronizer adjustment bolt and tighten to 15–22 ft. lbs. (20–30 Nm).

28. Remove the camshaft synchronizer positioning tool, then set the CMP sensor in position. Install the 2 hold-down bolts to 40–70 inch lbs. (4.5–7.8 Nm).

29. Attach the CMP sensor electrical connector.

NOTE: Reuse the EGR adapter gasket.

30. Install the EGR valve and adapter assembly. Tighten the mounting bolts to 71–102 inch lbs. (8.0–11.5 Nm).

31. Install the heater water outlet tube.

32. Install the upper EGR tube fitting to 25–34 ft. lbs. (34–47 Nm).

33. Attach the EGR valve vacuum hose.

34. Install the water pump.

35. Install the radiator, fan blade assembly and the fan shroud.

36. Fill the cooling system with the correct amount and type of coolant.

37. Connect the negative battery cable.

4.6L Engines (VIN W and VIN 6)

1. Connect the negative battery cable.

2. Remove both of the cylinder head covers.

3. Remove the radiator.

4. Remove the water pump.

5. Disconnect the following electrical connections:

- Both ignition coil connectors
- Camshaft Position (CMP) sensor electrical connector

• Both radio capacitor electrical connectors

6. Remove the ignition coils and brackets.

7. Raise and support the vehicle safely on jackstands.

8. Remove the 2 top power steering pump bolts.

9. Position and support the power steering pump aside. Leave the fluid lines connected.

10. Detach the Crankshaft Position (CKP) sensor electrical connector.

11. Remove the CKP sensor.

12. Drain the engine oil into an adequately-sized drain pan.

13. Remove the front 4 oil pan bolts.

14. Lower the vehicle.

15. Remove the front oil seal.

16. Remove the CMP sensor.

17. Remove the accessory drive belt idler pulley.

18. Remove the accessory drive belt tensioner.

19. Remove the 8 engine front cover bolts and the 7 front cover nuts.

20. Remove the front cover from the engine block.

21. Remove the crankshaft sensor ring from the crankshaft.

22. On VIN 6 engines, use the Camshaft Positioning Tool T96T-6256-A, or equivalent, to position the camshaft.

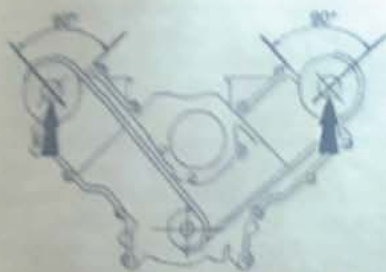
23. Rotate the crankshaft until both camshaft keyways are 90 degrees from the cylinder head cover surface (refer to the illustration). Make sure that the copper links in the chain line up with the dots on the camshaft sprockets.

24. On VIN W engines, install the Camshaft Positioning Tool T91P-6256-A and the Camshaft Positioning Tool Adapters T92P-6256-A, or their equivalents, on the camshaft.

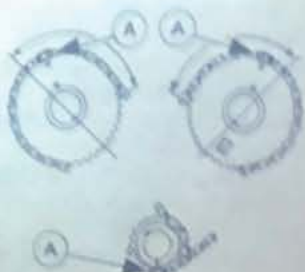
25. On VIN 6 engines, install the Camshaft Holding Tool T96T-6256-B, or equivalent, on the camshaft.

26. Remove the 2 left-hand timing chain tensioner bolts, then remove the tensioner.

27. Remove the 2 right-hand timing chain tensioner bolts, then remove the tensioner.



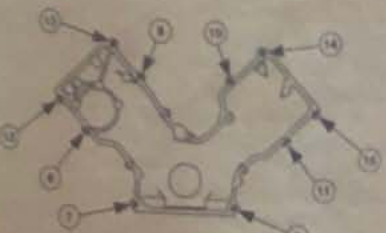
When removing the timing chains, rotate the crankshaft so that the camshafts are positioned as shown — 4.6L engines (VIN W and VIN 6)



When installing the timing chains, make certain that the copper colored links are aligned with the timing marks — 4.6L engine (VIN W and VIN 6)



Tighten the first 5 front cover fasteners in the sequence shown —



... continue tightening the other fasteners as shown here — 4.6L engines (VIN W and VIN 6)

28. Remove the right-hand and left-hand timing chain tensioner guides from the dowel pins.

WARNING

At no time, when the timing chains are removed and the cylinder heads are installed may the crankshaft or camshaft be rotated. Severe piston and valve damage will occur.

29. Remove the right-hand timing chain from the camshaft sprocket, then remove the right-hand chain and outer crankshaft sprocket from

the crankshaft. Perform the same for the left-hand timing chain.
30. Remove the chain guides.

NOTE: The manufacturer does not give procedures for the removal of the camshaft sprockets on the VIN 6 engines. The VIN 6 camshaft sprockets are not attached to the camshafts with a bolt.

31. On VIN W engines, remove the camshaft sprocket bolt, then remove the sprocket from the camshaft.
To install:

WARNING

The timing chain procedures must be followed exactly or damage to the valves and pistons will result.

32. On VIN W engines, position the camshaft sprocket on the camshaft. Install the retaining bolt to 81–95 ft. lbs. (110–130 Nm).

33. Release the lock assembly on the timing chain tensioners, then compress them. Install retaining pins to hold them in the retracted position.

34. Install the timing chain guides. Tighten the guide mounting bolts to 71–107 inch lbs. (8–12 Nm).

35. Install the crankshaft sprocket onto the crankshaft, aligning the copper link on the timing chain with the dot on the crankshaft. Position the timing chain over the camshaft sprocket, aligning the copper link with the dot on the camshaft sprocket.

36. Make sure that the copper marks on the timing chain are lined up with the corresponding dots on the crankshaft sprockets.

37. Make sure that the camshaft sprocket keyways are still in the same position as before: 90 degrees from the cylinder head cover mounting surface.

38. Make certain that the right-hand timing chain gear is on the outside of the left-hand timing chain gear with the hubs facing each other.

39. Position the timing chain guides on the dowel pins.

40. Install the timing chain tensioners. Install the mounting bolts until tight.

41. Remove the retaining pins from the tensioners.

42. On VIN W engines, remove the camshaft positioning tool and the camshaft positioning tool adapters from the camshafts.

43. On VIN 6 engines, remove the camshaft holding tool from the camshafts.

44. Install the crankshaft sensor ring on the crankshaft.

45. Apply silicone along the head-to-block surface and the oil pan-to-block surface. Use Silicone Gasket and Sealant F6AZ-19562-A or equivalent.

46. Install the engine front cover on the engine block dowel.

47. Loosely install the front cover bolts and nuts.

NOTE: Make certain to tighten the front cover bolts and nuts in 2 steps.

48. Tighten the front cover bolts and nuts in the sequence shown. In the first step, fasteners numbered 1–5 should be tightened to 15–22 ft. lbs. (20–30 Nm). In the second step, only fasteners numbered 6–15 should be tightened to 29–40 ft. lbs. (40–55 Nm) for VIN 6 engines and to 15–22 ft. lbs. (20–30 Nm) on VIN W engines. In the second step, fasteners numbered 1–5 are not retightened.

49. Install the belt idler pulley and install the belt idler pulley bolt to 15–22 ft. lbs. (20–30 Nm).

50. Install the accessory drive belt tensioner in place, then install and tighten the 3 mounting bolts to 15–22 ft. lbs. (20–30 Nm).

51. Install the CMP sensor. Tighten the CMP sensor mounting bolt to 70–106 inch lbs. (8–12 Nm).

52. Install a new front oil seal.

53. Raise and safely support the front of the vehicle on jackstands.

54. Loosely install the 4 front oil pan bolts.

NOTE: Make sure to tighten the 4 front oil pan bolts in 2 steps.

55. Tighten the 4 front bolts from the left-hand side of the engine to the right-hand side of the engine to 15 ft. lbs. (20 Nm). Then tighten the 4 bolts an additional 60 degrees (one bolt head flat).

56. Position the CKP sensor and install the hold-down bolt. Tighten the hold-down bolt to 72-107 ft. lbs. (8-12 Nm).

57. Attach the CKP sensor electrical connector.

58. Install the power steering pump. Tighten the mounting bolts to 15-20 ft. lbs. (20-30 Nm).

59. Lower the vehicle.

60. Install the ignition coils and brackets.

61. Attach the ignition coil, the radio capacitor and the CMP electrical connectors.

62. Install the cylinder head covers.

63. Install the radiator.

64. Connect the negative battery cable.

65. Fill the engine with the correct amount and type of engine oil, if necessary.

5.0L (VIN N) and 5.8L (VIN H and R) Engines

1. Drain the cooling system and the crankcase.

2. Disconnect the upper and lower radiator hoses from the water pump, transmission oil cooler lines from the radiator, and remove the radiator.

3. Disconnect the heater hose from the water pump. Slide the water pump by-pass hose clamp toward the water pump.

4. Loosen the alternator pivot bolt and the bolt which secures the alternator adjusting arm to the water pump. Position the alternator out of the way.

5. Remove the power steering pump and air conditioning compressor from their mounting brackets, if equipped.

6. Remove the bolts holding the fan shroud to the radiator, if equipped. Remove the fan, spacer, pulley and drive belts.

7. Remove the crankshaft pulley from the crankshaft damper. Remove the damper attaching bolt and washer and remove the damper with a puller.

8. Disconnect the fuel pump outlet line at the fuel pump. Disconnect the vacuum inlet and outlet lines from the fuel pump. Remove the fuel pump attaching bolts and lay the pump to one side with the fuel inlet line still attached.

9. Remove the oil level dipstick and the bolt holding the dipstick tube to the exhaust manifold on the 5.0L (VIN N) engine.

10. Remove the oil pan-to-cylinder front cover attaching bolts. Use a sharp, thin cutting blade to cut the oil pan gasket flush with the cylinder

block. Remove the front cover and water pump as an assembly.

11. Discard the front cover gasket.

12. Rotate the crankshaft counterclockwise to take up the slack on the left side of the chain.

13. Establish a reference point on the cylinder block and measure from this point to the chain.

14. Rotate the crankshaft in the opposite direction to take up the slack on the right side of the chain.

15. Force the left side of the chain out and measure the distance between the reference point and the chain. The timing chain deflection is the difference between the 2 measurements. If the deflection exceeds $\frac{1}{2}$ in. (13mm), replace the timing chain and sprockets.

16. Turn the crankshaft until the timing marks on the sprockets are aligned vertically.

17. Remove the camshaft sprocket retaining screw and remove the fuel pump eccentric and washers.

18. Alternately slide both of the sprockets and timing chain off the crankshaft and camshaft until free of the engine.

To install:

19. Position the timing chain on the sprockets so the timing marks on the sprockets are aligned vertically. Alternately slide the sprockets and chain onto the crankshaft and camshaft sprockets.

20. Install the fuel pump eccentric washers and attaching bolt on the camshaft sprocket. Tighten to 40-45 ft. lbs. (54-61 Nm).

21. Place the front seal removing tool (Ford part no. T70P-6B070-A or equivalent) into the front cover plate and over the front of the seal. Tighten the 2 through bolts to force the seal puller under the seal flange, then alternately tighten the 4 puller bolts a half turn at a time to pull the oil seal from the cover.

22. Coat a new front cover oil seal with Lubriplate® or equivalent and place it onto the front oil seal alignment and installation tool (Ford part no. T70P-6B070-A or equivalent). Place the tool and the seal onto the end of the crankshaft and push it toward the engine until the seal starts into the front cover.

23. Place the installation screw, washer, and nut onto the end of the crankshaft, then thread the screw into the crankshaft. Tighten the nut against the washer and tool to force the seal into the front cover plate. Remove the tool.

24. Apply Lubriplate® or equivalent to the oil seal rubbing sur-

face of the vibration damper inner hub to prevent damage to the seal. Coat the front of the crank shaft with oil for damper installation.

25. To install the damper, line up the damper keyway with the key on the crankshaft, then install the damper onto the crankshaft. Install the cap screw and washer, and tighten the screw to 80 ft. lbs. (109 Nm). Install the crankshaft pulley.

26. Install the fan, spacer, pulley and drive belts.

27. Install the bolts holding the fan shroud to the radiator, if equipped.

28. Install the power steering pump and air conditioning compressor.

29. Position and tighten the alternator.

30. Connect the heater hose at the water pump.

31. Install the radiator.

32. Connect the upper and lower radiator hoses, and transmission oil cooler lines.

33. Fill the cooling system and the crankcase.

7.5L (VIN G) Engine

1. Drain the cooling system and crankcase.

2. Remove the radiator shroud and fan.

3. Disconnect the upper and lower radiator hoses, and the automatic transmission oil cooler lines from the radiator.

4. Remove the radiator upper support and remove the radiator.

5. Loosen the alternator attaching bolts and air conditioning compressor idler pulley and remove the drive belts with the water pump pulley. Remove the bolts attaching the compressor support to the water pump and remove the bracket (support), if equipped.

6. Remove the crankshaft pulley from the vibration damper. Remove the bolt and washer attaching the crankshaft damper and remove the damper with a puller. Remove the woodruff key from the crankshaft.

7. Loosen the by-pass hose at the water pump, and disconnect the heater return tube at the water pump.

8. Disconnect and plug the fuel inlet and outlet lines at the fuel pump, and remove the fuel pump.

9. Remove the bolts attaching the front cover to the cylinder block. Cut the oil pan seal flush with the cylinder block face with a thin knife blade prior to separating the cover from the cylinder block. Remove the cover and water pump as an assembly. Discard

the front cover gasket and oil pan seal.

10. Rotate the crankshaft counter-clockwise to take up the slack on the left side of the chain.

11. Establish a reference point on the cylinder block and measure from this point to the chain.

12. Rotate the crankshaft in the opposite direction to take up the slack on the right side of the chain.

13. Force the left side of the chain out and measure the distance between the reference point and the chain. The timing chain deflection is the difference between the 2 measurements. If the deflection exceeds $\frac{1}{8}$ in. (13mm), replace the timing chain and sprockets.

14. Turn the crankshaft until the timing marks on the sprockets are aligned vertically.

15. Remove the camshaft sprocket retaining screw and remove the fuel pump eccentric and washers.

16. Alternately slide both of the sprockets and timing chain off the crankshaft and camshaft until free of the engine.

To install:

17. Position the timing chain on the sprockets so the timing marks on the sprockets are aligned vertically. Alternately slide the sprockets and chain onto the crankshaft and camshaft sprockets.

18. Install the fuel pump eccentric washers and attaching bolt on the camshaft sprocket. Tighten to 40-45 ft. lbs. (54-61 Nm).

19. Transfer the water pump if a new cover is going to be installed. Clean all of the gasket sealing surfaces on both the front cover and the cylinder block.

20. Coat the gasket surface of the oil pan with sealer. Cut and position the required sections of a new seal on the oil pan. Apply sealer to the corners.

21. Drive out the old front cover oil seal with a pin punch. Clean out the

seal recess in the cover. Coat a new seal with Lubriplate® or equivalent grease. Install the seal, making sure the seal spring remains in the proper position. A front cover seal tool, Ford part no. T72J-117 or equivalent, makes installation easier.

22. Coat the gasket surfaces of the cylinder block and cover with sealer and position the new gasket on the block.

23. Position the front cover on the cylinder block. Use care not to damage the seal and gasket or misplace them.

24. Coat the front cover attaching screws with sealer and install them.

NOTE: It may be necessary to force the front cover downward to compress the oil pan seal in order to install the front cover attaching bolts. Use a prybar or drift to engage the cover screw holes through the cover and pry downward.

25. Install the fuel pump.

26. Connect the fuel inlet and outlet lines at the fuel pump.

27. Tighten the by-pass hose at the water pump.

28. Connect the heater return tube at the water pump.

29. Install the woodruff key from the crankshaft.

30. Install the damper.

31. Install the crankshaft pulley on the vibration damper.

32. Install the compressor support on the water pump and install the bracket (support), if equipped.

33. Install the drive belts with the water pump pulley.

34. Install the radiator and upper support.

35. Connect the upper and lower radiator hoses, and the automatic transmission oil cooler lines.

36. Install the radiator shroud and fan.

37. Fill the cooling system and crankcase.

Observe the following torques:

- Front cover bolts: 15-20 ft. lbs. (20-27 Nm)

- Water pump attaching screws: 12-15 ft. lbs. (16-20 Nm)

- Crankshaft damper: 70-90 ft. lbs. (95-122 Nm)

- Crankshaft pulley: 35-50 ft. lbs. (47-68 Nm)

- Fuel pump: 19-27 ft. lbs. (26-37 Nm)

- Oil pan bolts: 9-11 ft. lbs. (12.2-15.0 Nm) for the $\frac{1}{8}$ in. (7.9mm) screws and to 7-9 ft. lbs. (9.5-12.2 Nm) for the $\frac{1}{4}$ in. (6.3mm) screws

- Alternator pivot bolt: 45-57 ft. lbs. (61-77 Nm)

Timing Gears and Front Cover

REMOVAL AND INSTALLATION

4.9L (VIN Y and Z) Engine

1. Drain the cooling system and disconnect the radiator upper hose at the coolant outlet elbow and remove the 2 upper radiator retaining bolts.

2. Raise the vehicle and drain the crankcase.

3. Remove the splash shield and the automatic transmission oil cooling lines, if equipped, then remove the radiator.

4. Loosen and remove the fan belt, fan and pulley.

5. Use a gear puller to remove the crankshaft pulley damper.

6. Remove the front cover retaining bolts and gently pry the cover away from the block. Remove the gasket.

7. Turn the crankshaft until the timing marks on the camshaft and crankshaft gears are aligned.

8. Use a gear puller to remove both of the timing gears.

To install:

9. Before installing the timing gears, be sure the key and spacer are properly installed. Align the gear key way with the key and install the gear on the camshaft. Be sure the timing marks line up on the camshaft and the crankshaft gears and install the crankshaft gear.

10. Clean the front cover and the gasket surface of the cylinder block. Apply an oil-resistant sealer to the new front cover gasket and install the gasket onto the cover.

11. Position the front cover assembly over the end of the crankshaft and against the cylinder block. Start, but do not tighten, the cover and pan attaching screws. Slide a front cover alignment tool (Ford part no. T68P-6019-A or equivalent) over the crank stub and into the seal bore of the cover. Tighten all front cover and oil pan attaching screws to 12-18 ft. lbs. (16-25 Nm) front cover; 10-15 ft. lbs. (14-20 Nm) oil pan, tightening the oil pan screws first.

NOTE: Trim away the exposed portion of the old oil pan gasket flush with the front of the engine block. Cut and position the required portion of a new gasket to the oil pan and apply sealer to both sides.

12. Lubricate the hub of the crankshaft damper pulley with Lubriplate® to prevent damage to



Timing chain and sprocket alignment — 5.0L (VINN), 5.8L (VINH and R) and 7.5L (VIN G) engine

5 FORD MOTOR CO. BRONCO/E-SERIES VAN/EXPEDITION

the seal during installation or on initial starting of the engine.

13. Install the fan belt, fan and pulley.

14. Install the radiator.

15. Install the splash shield and the automatic transmission oil cooling lines, if equipped.

16. Fill the crankcase.

17. Connect the radiator upper hose at the coolant outlet elbow and install the 2 upper radiator retaining bolts.

18. Drain the cooling system.

19. Start the engine and check for leaks.

Camshaft

REMOVAL AND INSTALLATION

4.2L (VIN 2) Engine

1. Remove the valve lifters.

2. Remove the timing chain and sprockets.

3. Remove the camshaft key from the end of the camshaft, then slide the engine dynamic balance shaft drive gear off of the camshaft.

4. Remove the 2 camshaft thrust plate retaining bolts (1), then remove the thrust plate (2). Remove the camshaft spacer (3), then slide the camshaft (4) out of the front of the engine block. Be cautious not to gouge or scratch the camshaft bearing journals.

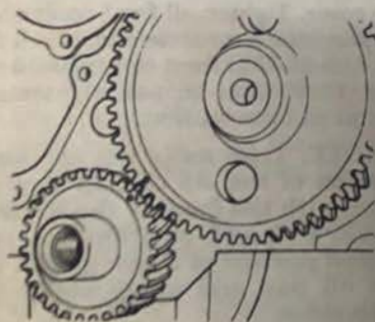
To install:

5. Lubricate the camshaft with engine oil prior to installation.

6. Carefully slide the camshaft into the camshaft bore. Do not scratch the bearing surfaces.

7. Install the camshaft thrust plate with the spacer. Tighten the thrust plate mounting bolts to 6-10 ft. lbs. (8-14 Nm).

8. Slide the engine dynamic balance shaft drive gear onto the camshaft. Install the camshaft key to the camshaft groove.



Timing gear alignment — 4.9L (VIN Y and Z) engine

9. Install the timing chain and sprockets.

10. Install the valve lifters.

4.6L Engines

1. Remove the cylinder head covers from the engine.

2. Remove the timing chain.

CAUTION

At no time, when the timing chains are removed and the cylinder heads are installed may the crankshaft or camshaft be rotated. Severe piston and valve damage will occur.

3. Remove the camshaft roller lifters.

4. On VIN W engines, remove the timing chain camshaft gear by removing the gear retaining bolt.

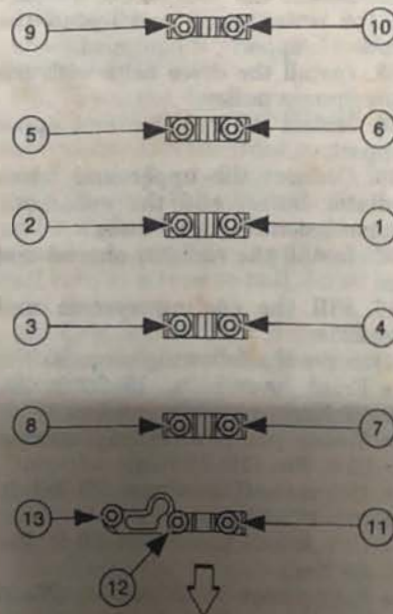
5. Remove the camshaft bearing cap bolts, then lift the camshaft bearing caps off of the cylinder head.

6. Lift the camshaft from the cylinder head.

To install:

7. Lubricate the camshaft journals and bearing caps with engine oil which meets Ford specifications WSE-M2C908-A1.

8. Lower the camshaft onto the camshaft bearing journals.



For VIN 6 engines, tighten the camshaft bearing caps in the sequence shown — 4.6L VIN 6 engines

9. Install the camshaft bearing caps, then loosely install the bearing cap bolts.

10. Tighten the camshaft bearing cap mounting bolts, in the sequence shown for the particular engine, to 71-107 inch lbs. (8-12 Nm).

11. On VIN W engines, install the camshaft timing chain gear by tightening the retaining bolt to 81-95 ft. lbs. (110-130 Nm).

12. Install the valve lifters.

13. Install the timing chain and sprockets, if applicable.

14. Install the cylinder head covers.

4.9L (VIN Y and Z) Engine

1. Remove the grille, radiator, air conditioner condenser, and timing cover.

2. Remove the distributor, fuel pump, oil pan and oil pump.

3. Align the timing marks. Unbolt the camshaft thrust plate, working through the holes in the camshaft gear.

4. Loosen the rocker arms, remove the pushrods, take off the side cover and remove the valve lifter with a magnet.

5. Remove the camshaft very carefully to prevent nicking the bearings.

To install:

6. Oil the camshaft bearing journals and use Lubriplate® or something similar on the lobes. Install the camshaft, gear, and thrust plate, aligning the gear marks. Tighten down the thrust plate. Make sure the camshaft end-play is not excessive.

7. Install the rocker arms, pushrods and valve lifters.

8. Install the camshaft timing gear.

9. Install the oil pump, oil pan and fuel pump.

10. Install the distributor. The rotor should be at the firing position for no. 1 cylinder, with the timing gear marks aligned.

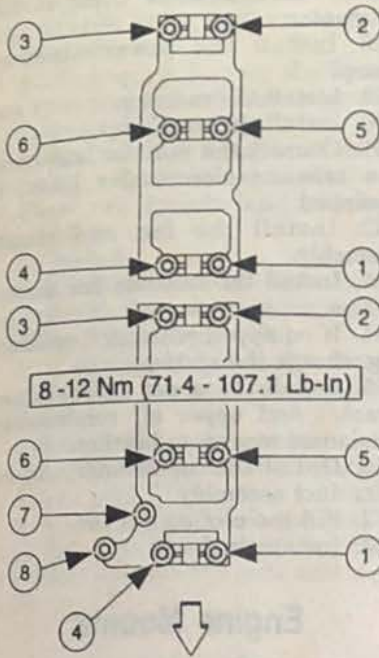
11. Install the front engine cover, A/C condenser, the radiator and the grille.

5.0L (VIN N), 5.8L (VIN H and R) and 7.5L (VIN G) Engines

1. Remove the intake manifold and valley pan, if equipped.

2. Remove the rocker covers, and either remove the rocker arm shafts or loosen the rockers on their pivots and remove the pushrods. The pushrods must be reinstalled in their original positions.

3. Remove the valve lifters in sequence with a magnet. They must be replaced in their original positions.



For VIN W engines, tighten the camshaft bearing caps in the sequence shown — 4.6L VIN W engines

4. Remove the timing gear cover, timing chain and sprockets.

5. In addition to the radiator and air conditioning condenser, if equipped, it may be necessary to remove the front grille assembly and the hook lock assembly to gain the necessary clearance to code the camshaft out of the front of the engine.

NOTE: A camshaft removal tool, Ford part no. T65L-6250-A and adaptor 14-0314 are needed to remove the Diesel camshaft.

To install:

6. Coat the camshaft with oil liberally before installing it. Slide the camshaft into the engine very carefully so as not to scratch the bearing bores with the camshaft lobes. Install the camshaft thrust plate and tighten the attaching screws to 9-12 ft. lbs. (12-16 Nm). Measure the camshaft end-play. If the end-play is more than 0.009 in. (0.228mm), replace the thrust plate. Assemble the remaining components in the reverse order of removal.

7. Install the radiator, front grille, hood lock assembly and air conditioning condenser, if removed.

8. Install the timing chain and and front cover.

9. Install the valve lifters. They must be replaced in their original positions.

10. Install the pushrods, the rocker arms and the rocker arm covers.

11. Install the intake manifold and valley pan, if equipped.

Balance Shaft

REMOVAL AND INSTALLATION

4.2L (VIN 2) Engine

1. Remove the timing chain.
2. Remove the 2 engine dynamic balance shaft thrust plate bolts, then the engine dynamic balance shaft gear, thrust plate and engine dynamic balance shaft.

To install:

3. Turn the camshaft so that the timing mark is at 12 o'clock and install the engine dynamic balance shaft assembly into the cylinder block so that the balance shaft gear timing mark lines up with the camshaft timing mark.

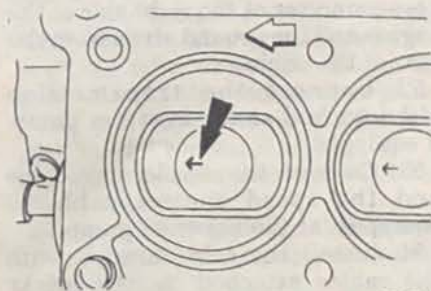
NOTE: If properly aligned, the engine dynamic balance shaft keyway will be at 12 o'clock and the camshaft keyway will be at 6 o'clock on the camshaft.

4. Install the 2 engine dynamic balance shaft thrust plate bolts to 6-10 ft. lbs. (8-14 Nm).

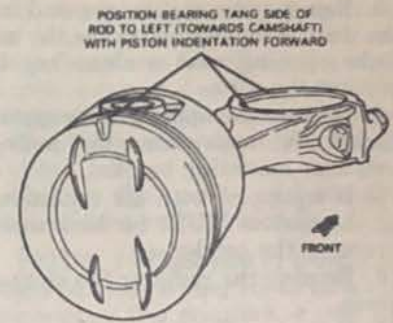
5. Install the timing chain.

Piston and Connecting Rod

POSITIONING

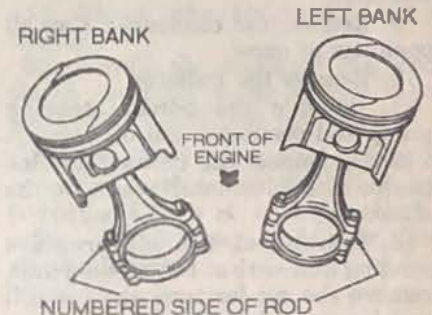


Position the pistons in the engine so that the arrow on the piston top is facing toward the front of the engine block — 4.2L (VIN 2) and 4.6L (VIN W and VIN 6) engines



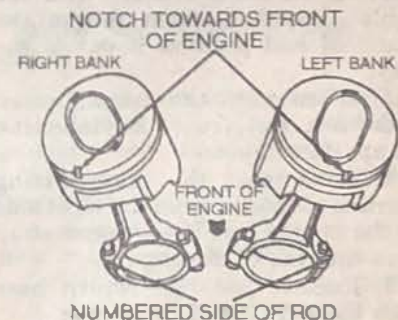
79215g57

Piston and connecting rod assembly — 4.9L (VIN Y and Z) engine



79215g68

Piston and connecting rod assembly — 5.0L (VIN N) and 5.8L (VIN H and R) engines



79215g89

Piston and connecting rod assembly — 7.5L (VIN G) engine

DIESEL ENGINE MECHANICAL

Engine Assembly

REMOVAL AND INSTALLATION

7.3L (VIN C, F, K, and M) Diesel Engine

1. Remove the hood.
2. Drain the coolant.

3. Remove the air cleaner and intake duct assembly and cover the air intake opening with a clean rag to keep out the dirt.

4. Remove the upper grille support bracket and upper air conditioning condenser mounting bracket.

5. If equipped with air conditioning, the system **MUST** be discharged to remove the condenser.

6. Remove the radiator fan shroud halves.

7. Remove the fan and clutch assembly.

8. Detach the radiator hoses and the transmission cooler lines, if equipped.

9. Remove the condenser. Cap all openings at once!

10. Remove the radiator.

11. Remove the power steering pump and position it out of the way.

12. Disconnect the fuel supply line heater and alternator wires at the alternator.

13. Disconnect the oil pressure sending unit wire at the sending unit, remove the sender from the firewall and lay it on the engine.

14. Disconnect the accelerator cable and the speed control cable, if equipped, from the injection pump. Remove the cable bracket with the cables attached, from the intake manifold and position it out of the way.

15. Disconnect the transmission kickdown rod from the injection pump, if equipped.

16. Disconnect the main wiring harness connector from the right side of the engine and the ground strap from the rear of the engine.

17. Remove the fuel return hose from the left rear of the engine.

18. Remove the 2 upper transmission-to-engine attaching bolts.

19. Disconnect the heater hoses.

20. Disconnect the water temperature sender wire.

21. Disconnect the overheat light switch wire and position the wire out of the way.

22. Raise the vehicle and support on it on jackstands.

23. Disconnect the battery ground cables from the front of the engine and the starter cables from the starter.

24. Remove the fuel inlet line and plug the fuel line at the fuel pump.

25. Detach the exhaust pipe at the exhaust manifold.

26. Disconnect the engine insulators from the no. 1 crossmember.

27. Remove the flywheel inspection plate and the 4 converter-to-flywheel

attaching nuts, if equipped with automatic transmission.

28. Remove the jackstands and lower the vehicle.

29. Supporting the transmission on a jack.

30. Remove the 4 lower transmission attaching bolts.

31. Attach an engine lifting sling and remove the engine from the vehicle.

To install:

32. Lower the engine into vehicle.

33. Align the converter to the flexplate and the engine dowels to the transmission.

34. Install the engine mount bolts and torque them to 80 ft. lbs. (109 Nm).

35. Remove the engine lifting sling.

36. Install the 4 lower transmission attaching bolts. Torque the bolts to 65 ft. lbs. (88 Nm).

37. Remove transmission jack.

38. Raise and support the front end on jackstands.

39. If equipped with automatic transmission, install the 4 converter-to-flywheel attaching nuts. Torque the nuts to 34 ft. lbs. (47 Nm).

40. Install the flywheel inspection plate. Torque the bolts to 60-90 inch lbs. (6.7-10.0 Nm).

41. Attach the exhaust pipe at the exhaust manifold.

42. Connect the fuel inlet line.

43. Connect the battery ground cables to the front of the engine.

44. Connect the starter cables at the starter.

45. Lower the vehicle.

46. Connect the overheat light switch wire.

47. Connect the water temperature sender wire.

48. Connect the heater hoses.

49. Install the 2 upper transmission-to-engine attaching bolts. Torque the bolts to 65 ft. lbs. (88 Nm).

50. Connect the fuel return hose at the left rear of the engine.

51. Connect the main wiring harness connector at the right side of the engine and the ground strap from the rear of the engine.

52. Connect the transmission kickdown rod at the injection pump, if equipped.

53. Connect the accelerator cable and the speed control cable, if equipped, at the injection pump.

54. Install the cable bracket with the cables attached, to the intake manifold.

55. Install the oil pressure sending unit.

56. Connect the oil pressure sending unit wire at the sending unit.

57. Connect the fuel supply line heater and alternator wires at the alternator.

58. Install the power steering pump.

59. Install the radiator.

60. Install the condenser.

61. Connect the radiator hoses and the transmission cooler lines, if equipped.

62. Install the fan and clutch assembly.

63. Install the radiator fan shroud halves.

64. If equipped with air conditioning, charge the system.

65. Install the upper grille support bracket and upper air conditioning condenser mounting bracket.

66. Install the air cleaner and intake duct assembly.

67. Fill the cooling system.

68. Install the hood.

Engine Mounts

REMOVAL AND INSTALLATION

Front Mounts

1. Remove the fan shroud attaching screws.

2. Support the engine using a wood block and a jack placed under the oil pan.

3. Remove the nuts and washers attaching the mounts to the engine bracket. Lift the engine enough to disengage the mount upper stud from the crossmember engine bracket.

4. Remove the bolt attaching the fuel pump shield to the left engine bracket, if necessary.

5. Remove the mount-to-crossmember attaching nut and washer assembly. Remove the engine mount.

To install:

6. Install the engine mount to the crossmember.

7. Install the bolt attaching the fuel pump shield to the left bracket, if necessary.

8. Lower the engine until the mount stud engages in the slot/hole of the engine bracket. Install the attaching nuts.

9. Remove the jack and wood block from the engine oil pan. Install the fan shroud attaching screws.

Rear Mount

1. Place a block of wood and a jack under the transmission.

2. Remove the 2 nuts attaching the mount to the crossmember. Raise the transmission enough to lift the mount from the crossmember.

3. Remove the bolts and nuts attaching the crossmember to the frame side rails and remove the crossmember.

4. If equipped, remove the fasteners attaching the exhaust hanger to the rear engine mount.

5. Remove the 2 bolts attaching the mount to the transmission and remove the mount and retainer assembly.

To install:

6. Position the mount and retainer assembly to the transmission and install the 2 attaching bolts.

7. If equipped, install the fasteners attaching the exhaust hanger to the mount.

8. Install the crossmember to the frame side rails with the attaching nuts and bolts.

9. Lower the transmission and install the mount crossmember attaching nuts. Remove the jack and wood block.

Cylinder Head

REMOVAL AND INSTALLATION

7.3L (VIN C, F, K, and M) Diesel Engine

1. Open the hood and disconnect the negative cables from both batteries.

2. Drain the cooling system and remove the radiator fan shroud halves.

3. Remove the radiator fan and clutch assembly using special tool T83T-6312-A and B. This tool is available through the Owatonna Tool Co. whose address is listed in the front of this book, or through Ford Dealers. It is also available through many tool rental shops.

NOTE: The fan clutch uses a left hand thread and must be removed by turning the nut clockwise.

4. Label and disconnect the wiring from the alternator.

5. Remove the adjusting bolts and pivot bolts from the alternator and the vacuum pump and remove both units.

6. Remove the fuel filter lines and cap to prevent fuel leakage.

7. Remove the alternator, vacuum pump, and fuel filter brackets with the fuel filter attached.

8. Remove the heater hose from the cylinder head.

9. Remove the fuel injection pump.

10. Remove the intake manifold and valley cover.

11. Raise the vehicle and safely support it with jackstands.

12. Disconnect the exhaust pipes from the exhaust manifolds.

13. Remove the clamp holding the oil dipstick tube in place and the bolt attaching the transmission oil dipstick to the cylinder head.

14. Lower the vehicle.

15. Remove the oil dipstick tube.

16. Remove the valve covers, rocker arms and pushrods. Keep the pushrods in order so they can be returned to their original positions.

17. Remove the nozzles and glow plugs.

18. Remove the cylinder head bolts and attach lifting eyes, using special tool T70P-6000 or equivalent, to each end of the cylinder heads.

19. Carefully lift the cylinder heads out of the engine compartment and remove the head gaskets.

NOTE: The cylinder head prechambers may fall out of the heads upon removal.

To install:

20. Position the cylinder head gasket on the engine block and carefully lower the cylinder head in place.

NOTE: Use care in installing the cylinder heads to prevent the prechambers from falling out into the cylinder bores.

21. Install the cylinder head bolt and torque in 4 steps using the sequence.

NOTE: Lubricate the threads and the mating surfaces of the bolt heads and washers with oil.

22. Dip the pushrod ends in clean oil and install the pushrods with the copper colored ends toward the rocker arms, making sure the pushrods are fully seated in the tappet pushrod seats.

23. Install the rocker arms and posts in their original positions. Apply Lubriplate® grease to the valve stem tips. Turn the engine over by hand until the timing mark is at the 11 o'clock position as viewed from the front. Install the rocker arm posts, bolts, and torque to 27 ft. lbs. (37 Nm). Install the valve covers.

24. Install the valley pan and the intake manifold.

25. Install the fuel injection pump.

26. Connect the heater hose to the cylinder head.

27. Install the fuel filter, alternator, vacuum pump, and their drive belts.

28. Install the oil and transmission dip stick.

29. Connect the exhaust pipe to the exhaust manifolds.

30. Reconnect the alternator wiring harness and replace the air cleaner. Connect both battery ground cables.

31. Refill and bleed the cooling system.

32. Run the engine and check for fuel, coolant and exhaust leaks.

NOTE: If necessary, purge the high pressure fuel lines of air by loosening the connector one half to one turn and cranking the engine until a solid stream of fuel, free from any bubbles, flows from the connections.

33. Check the injection pump timing.

34. Install the radiator fan and clutch assembly using special tools T83T-6312A and B or equivalent.

NOTE: The fan clutch uses a left hand thread. Tighten by turning the nut counterclockwise. Install the radiator fan shroud halves.

Valve Lifters

REMOVAL AND INSTALLATION

7.3L (VIN C, F, K, and M) Diesel Engine

1. Remove the intake manifold.

2. Remove the CDR tube and grommet from the valley pan.

3. Remove the valley pan strap from the front of the block.

4. Remove the valley pan drain plug and lift out the valley pan.

5. Remove the rocker arm covers.

6. Remove the rocker arms; keep them in order for installation.

7. Remove the pushrods; keep them in order for installation.

8. Remove the lifter guide retainer.

9. Using a magnetic lifter removal tool, remove the lifters. Wipe clean the exterior of each lifter as it's removed and mark it with an indelible marker, so it can be installed in its original bore.

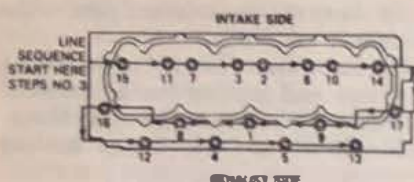
To install:

10. Coat the bottom surface of each lifter with multi-purpose grease, and coat the rest of the lifter with clean oil.

11. Install each lifter in its original bore using the magnetic tool.

12. Install the lifter guide retainer.

13. Install the pushrods, copper colored end up, into their original locations, making sure they are firmly seated in the lifters.



- STEP 1. TIGHTEN BOLTS TO 185 FT-LB IN NUMBERED SEQUENCE SHOWN ABOVE.
 STEP 2. TIGHTEN BOLTS TO 185 FT-LB IN NUMBERED SEQUENCE SHOWN ABOVE.
 STEP 3. TIGHTEN BOLTS TO 185 FT-LB IN LINE SEQUENCE SHOWN ABOVE.
 STEP 4. REPEAT STEP NO. 2.

73215g42

Cylinder head bolt torque sequence — 7.3L (VIN C, F, K, and M) Diesel engine

14. Coat the valve stem tips with multi-purpose grease and install the rocker arms and posts in their original positions.

15. Turn the crankshaft by hand, until the timing mark is at the 11 o'clock position — viewed from the front.

16. Install all the rocker arm post bolts and torque them to 20 ft. lbs. (27 Nm).

17. Install the rocker arm covers.

18. Clean all old RTV gasket material from the block and run a 1/8 in. (3mm) bead of new RTV gasket material at each end of the block. Within 15 minutes, install the valley pan. Install the pan drain plug.

19. Install the CDR tube, new grommet and new O-ring.

20. Install the intake manifold and related parts.

Rocker Arms

REMOVAL AND INSTALLATION

7.3L (VIN C, F, K, and M) Diesel Engine

1. Disconnect the ground cables from both batteries.

2. Remove the valve cover attaching screws and remove both valve cover.

3. Remove the valve rocker arm post mounting bolts. Remove the rocker arms and posts in order and mark them with tape so they can be installed in their original positions.

4. If the cylinder heads are to be removed, then the pushrods can now be removed. Make a holder for the pushrods out of a piece of wood or cardboard, and remove the pushrods in order. It is very important that the pushrods be re-installed in their original order. The pushrods can remain in position if no further disassembly is required.

5. If the pushrods were removed, install them in their original locations. make sure they are fully seated in the tappet seats.

NOTE: The copper colored end of the pushrod goes toward the rocker arm.

6. Apply a polyethylene grease to the valve stem tips. Install the rocker arms and posts in their original positions.

7. Turn the engine over by hand until the valve timing mark is at the 11:00 o'clock position, as viewed from the front of the engine. Install all of the rocker arm post attaching bolts and torque to 20 ft. lbs. (27 Nm).

8. Install new valve cover gaskets and install the valve cover. Install the battery cables, start the engine and check for leaks.

Intake Manifold

REMOVAL AND INSTALLATION

7.3L (VIN C, F, K, and M) Diesel Engine

1. Open the hood and remove both battery ground cables.

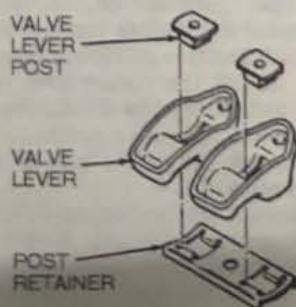
2. Remove the air cleaner and install clean rags into the air intake of the intake manifold. It is important that no dirt or foreign objects get into the Diesel intake.

3. Remove the injection pump.

4. Remove the fuel return hose from No. 7 and No. 8 rear nozzles and remove the return hose to the fuel tank.

5. Label the positions of the wires and remove the engine wiring harness from the engine.

NOTE: The engine harness ground cables must be removed from the back of the left cylinder head.



Rocker arm assembly — 7.3L (VIN C, F, K, and M) Diesel engine

6. Remove the bolts attaching the intake manifold to the cylinder heads and remove the manifold.

7. Remove the CDR tube grommet from the valley pan.

8. Remove the bolts attaching the valley pan strap to the front of the engine block, and remove the strap.

9. Remove the valley pan drain plug and remove the valley pan.

To install:

10. Apply a 1/8 in. (3mm) bead of RTV sealer to each end of the cylinder block.

NOTE: The RTV sealer should be applied immediately prior to the valley pan installation.

11. Install the valley pan drain plug, CDR tube and new grommet into the valley pan.

12. Install a new O-ring and new back-up ring on the CDR valve.

13. Install the valley pan strap on the front of the valley pan.

14. Install the intake manifold and torque the bolts to 24 ft. lbs. (33 Nm) using the sequence.

15. Reconnect the engine wiring harness and the engine ground wire located to the rear of the left cylinder head.

16. Install the injection pump.

17. Install the No. 7 and No. 8 fuel return hoses and the fuel tank return hose.

18. Remove the rag from the intake manifold and replace the air cleaner. Reconnect the battery ground cables to both batteries.

19. Run the engine and check for oil and fuel leaks.

NOTE: If necessary, purge the nozzle high pressure lines of air by loosening the connector one half to one turn and cranking the engine until solid stream of fuel, devoid of any bubbles, flows from the connection.

CAUTION

Keep eyes and hands away from the nozzle spray. Fuel spraying from the nozzle under high pressure can penetrate the skin.

20. Check and adjust the injection pump timing.

Exhaust Manifold

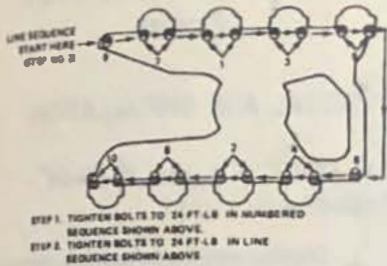
REMOVAL AND INSTALLATION

7.3L (VIN C, F, K, and M) Diesel Engine

1. Disconnect the ground cables from both batteries.

Turbocharger

REMOVAL AND INSTALLATION



79216g01

Intake manifold bolt torque sequence—7.3L (VIN C, F, K, and M) Diesel engine

2. Raise the vehicle and safely support it with jackstands.

3. Disconnect the muffler inlet pipe from the exhaust manifolds.

4. Lower the vehicle to remove the right manifold. When removing the left manifold, jack the truck up. Bend the tabs on the manifold attaching bolts, then remove the bolts and manifold.

To install:

5. Before installing, clean all mounting surfaces on the cylinder heads and the manifold. Apply an anti-seize compound on the manifold both threads and install the left manifold, using a new gasket and new locking tabs.

6. Torque the bolts to specifications and bend the tabs over the flats on the bolt heads to prevent the bolts from loosening.

7. Raise the vehicle to install the right manifold. Install the right manifold following procedures 5 and 6 above.

8. Connect the inlet pipes to the manifold and tighten. Lower the vehicle, connect the batteries and run the engine to check for exhaust leaks.

1. Disconnect the negative battery cable.

2. Remove the two air intake tube assembly bolts, clamps at the turbocharger, crankcase breather assembly, engine air cleaner and air intake tube and hoses.

3. Remove the exhaust outlet clamp from the turbocharger.

4. Raise and safely support the vehicle on jackstands.

5. Remove the engine charge exhaust pipe bolt from the transmission, if so equipped.

6. Remove the bolts and nuts from the catalytic converter-to-engine charge exhaust pipe, if so equipped.

7. Loosen two bolts retaining the turbocharger exhaust inlet pipe to the left exhaust manifold.

8. For automatic transmissions, remove the bolts retaining the left turbocharger exhaust inlet pipe to the turbocharger exhaust inlet adapter.

9. Loosen the two bolts retaining the turbocharger exhaust inlet pipe to the right exhaust manifold.

10. Remove the lower bolt retaining the right turbocharger exhaust inlet pipe to the turbocharger exhaust inlet adapter.

11. Lower the vehicle.

12. For automatic transmissions, remove the upper bolts retaining the right and left turbocharger exhaust inlet pipes to the turbocharger exhaust inlet adapter.

13. Remove the right engine lift hook and bolt.

14. Loosen the air inlet hose clamp at the turbocharger. Disconnect the hose and lay aside.

15. For automatic transmissions, loosen the 4 intake manifold hose clamps, and one clamp retaining the compressor manifold to the turbocharger. Remove the compressor manifold.

16. Remove the four bolts retaining the turbocharger pedestal assembly to the cylinder block.

17. Remove the turbocharger assembly and detach all electrical connectors from it.

NOTE: If the turbocharger is not being removed for service, install the Fuel/Oil turbo Protector Cap Set T94T-9395-AH or equivalent.

18. Remove the oil gallery O-rings.

To install:

19. Install new oil gallery O-rings.

20. Attach the turbocharger electrical connectors and install the turbocharger assembly.

21. Install the 4 bolts retaining the turbocharger pedestal assembly to the engine block. Tighten the bolts to 18 ft. lbs. (25 Nm).

22. Loosely install the 4 bolts retaining the right and left turbocharger exhaust inlet pipes to the turbocharger exhaust inlet adapter.

23. Install the compressor manifold, intake manifold hoses and clamps. Make sure the compressor outlet seal is in position.

24. Install the right engine lift hook and bolt.

25. Raise and safely support the front of the vehicle on jackstands.

26. Tighten the 2 right and left lower bolts (retaining the turbocharger exhaust inlet pipes to the turbocharger exhaust inlet adapter) to 36 ft. lbs. (49 Nm).

27. Tighten the 4 right and left bolts and nuts (retaining the turbocharger exhaust inlet pipes to the exhaust manifolds) to 36 ft. lbs. (49 Nm).

28. Install the catalytic converter to the engine charge exhaust pipe bolts and nuts.

29. Lower the vehicle.

30. Tighten the 2 right and left upper bolts (retaining the turbocharger exhaust inlet pipes to the turbocharger exhaust inlet adapter) to 36 ft. lbs. (49 Nm).

31. Install the exhaust outlet clamp to the turbocharger.

32. Install the air intake tube and hose assembly.

33. Connect the negative battery cable.

Front Cover Seal

REMOVAL AND INSTALLATION

7.3L (VIN C, F, K, and M) Diesel Engine

1. Disconnect both battery ground cables. Drain the cooling system.

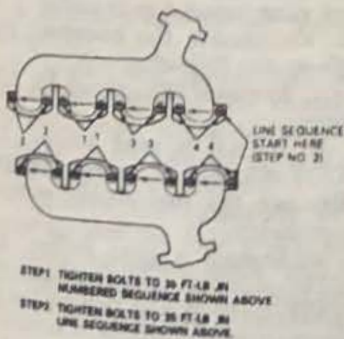
2. Remove the air cleaner and cover the air intake on the manifold with clean rags. Do not allow any foreign material to enter the intake.

3. Remove the radiator fan shroud halves.

4. Remove the fan and fan clutch assembly using a puller or ford tool No. T83T-6312-A.

NOTE: The nut is a left hand thread; remove by turning the nut clockwise.

5. Remove the injection pump.



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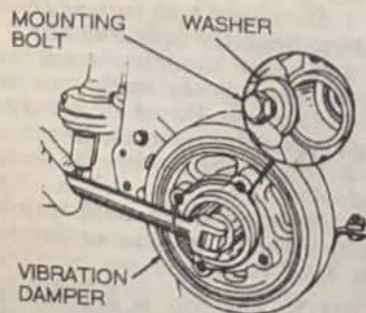
Exhaust manifold bolt torque sequence—7.3L (VIN C, F, K, and M) Diesel engine

6. Remove the water pump.
7. Raise the vehicle and safely support it with jackstands.
8. Remove the crankshaft pulley and vibration damper.
9. Remove the engine ground cables at the front of the engine.
10. Remove the 5 bolts attaching the engine front cover to the engine block and oil pan.
11. Lower the vehicle.
12. Remove the front cover.

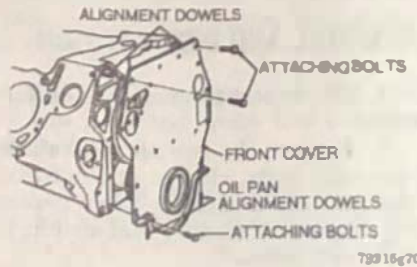
NOTE: The front cover oil seal on the Diesel must be driven out with an arbor press and a 3/4 in. (82.5mm) spacer.

To install:

13. Remove all old gasket material from the front cover, engine block, oil pan sealing surfaces and water pump surfaces.
14. Coat the new front oil seal with Lubriplate® or equivalent grease.
15. The new seal must be installed using a seal installation tool, Ford part no. T83T-6700-A or an arbor press. When the seal bottoms out on the front cover surface, it is installed at the proper depth.
16. Install alignment dowels into the engine block to align the front cover and gaskets. These can be made out of round stock. Apply a gasket sealer to the engine block sealing surfaces, then install the gaskets on the block.
17. Apply a 1/4 in. (3mm) bead of RTV sealer on the front of the engine block. Apply a 1/4 in. (6mm) bead of RTV sealer on the oil pan.
18. Install the front cover immediately after applying RTV sealer. The sealer will begin to cure and lose its effectiveness unless the cover is installed quickly.
19. Install the water pump gasket on the engine front cover. Apply RTV sealer to the 4 water pump bolts il-



Vibration damper removal — 7.3L (VIN C, F, K, and M) Diesel engine



Cylinder block front cover installation — 7.3L (VIN C, F, K, and M) engine

lustrated. Install the water pump and hand tighten all bolts.

WARNING

The 2 top water pump bolts must be no more than 1 1/4 in. (31.75mm) long. Bolts any longer will interfere with (hit) the engine drive gears.

20. Torque the water pump bolts to 19 ft. lbs. (26 Nm). Torque the front cover bolts to specifications according to bolt size (see Torque Specifications chart).
21. Install the injection pump adaptor and injection pump.
22. Install the heater hose fitting in the pump using pipe sealant, and connect the heater hose to the water pump.
23. Raise the vehicle and safely support it with jackstands.
24. Lubricate the front of the crankshaft with clean oil. Apply RTV sealer to the engine side of the retaining bolt washer to prevent oil seepage past the keyway. Install the crankshaft vibration damper using Ford Special tool T83T-6316B, or equivalent. Tighten the damper-to-crankshaft bolt to 90 ft. lbs. (122 Nm).
25. Install the fan and fan clutch assembly.

NOTE: The nut is a left hand thread; install by turning the nut clockwise.

26. Install the radiator fan shroud halves.
27. Install the air cleaner.
28. Connect both battery ground cables.
29. Fill the cooling system.

Timing Gears and Front Cover

REMOVAL AND INSTALLATION

7.3L (VIN C, F, K, and M) Diesel Engine

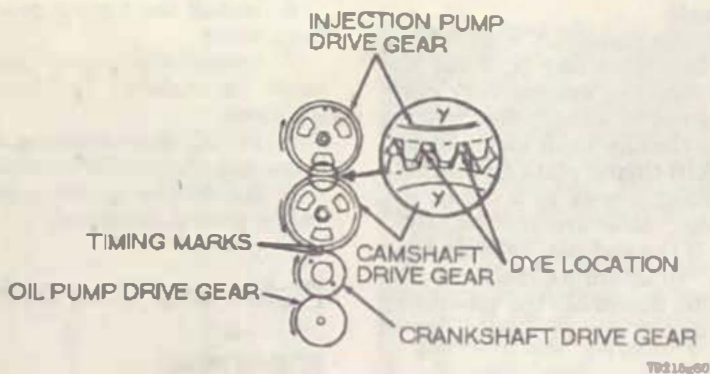
1. Disconnect both battery ground cables. Drain the cooling system.
2. Remove the air cleaner and cover the air intake on the manifold with clean rags. Do not allow any foreign material to enter the intake.
3. Remove the radiator fan shroud halves.
4. Remove the fan and fan clutch assembly using a puller or Ford tool No. T83T-6312-A.

NOTE: The nut is a left hand thread; remove by turning the nut clockwise.

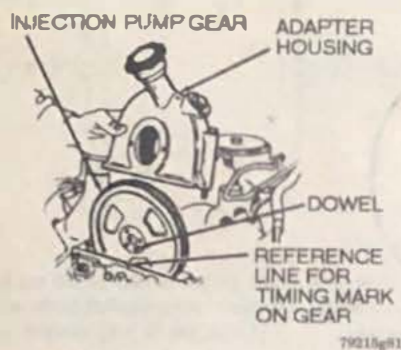
5. Remove the injection pump.
6. Remove the water pump.
7. Raise the vehicle and safely support it with jackstands.
8. Remove the crankshaft pulley and vibration damper.
9. Remove the engine ground cables at the front of the engine.
10. Remove the 5 bolts attaching the engine front cover to the engine block and oil pan.
11. Lower the vehicle.
12. Remove the front cover.

NOTE: The front cover oil seal on the Diesel must be driven out with an arbor press and a 3/4 in. (82.5mm) spacer.

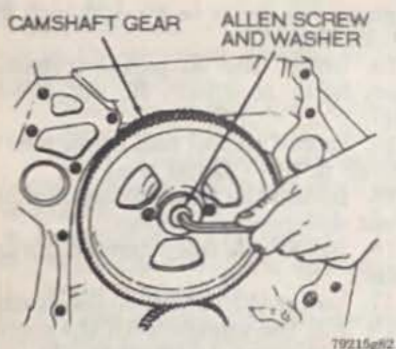
13. To remove the crankshaft gear, install the crankshaft drive gear remover Tool T83T-6316-A, and using a breaker bar to prevent crankshaft rotation, or flywheel holding Tool T74R-6375-A, remove the crankshaft gear.
14. Remove the injection pump drive gear using a gear puller.
15. To remove the camshaft gear, perform the following:
 - a. Remove the camshaft Allen screw.
 - b. Install a gear puller, Tool T83T-6316-A and remove the gear. Remove the fuel supply pump, if necessary.
 - c. Install a gear puller, Tool T77E-4220-B and shaft protector T83T-6316-A and remove the fuel pump cam and spacer, if necessary.
 - d. Remove the bolts attaching the thrust plate, and remove the thrust plate, if necessary.



Timing sprocket alignment—7.3L (VIN C, F, K, and M) Diesel engine



Injection pump drive sprocket cover—7.3L (VIN C, F, K, and M) Diesel engine



Camshaft drive sprocket removal—7.3L (VIN C, F, K, and M) Diesel engine

To install:

16. Install the camshaft timing gear as follows:

- Install a new thrust plate, if removed.
- Install the spacer and fuel pump cam against the camshaft thrust flange, using installation sleeve and replacer Tool T83T-6316-B, if removed.
- Install the camshaft drive gear against the fuel pump cam, aligning the timing mark with the timing mark on the crankshaft drive gear, using installation

sleeve and replacer Tool T83T-6316-B.

d. Install the camshaft Allen screw and tighten to 18 ft. lbs. (26 Nm).

17. Install the injection pump drive gear in position, aligning all the drive gear timing marks.

NOTE: To determine that the No. 1 piston is at TDC of the compression stroke, position the injection pump drive gear dowel at the 4 o'clock position. The scribe line on the vibration damper should be at TDC. Use extreme care to avoid disturbing the injection pump drive gear, once it is in position.

18. Install the crankshaft gear using Tool T83T-6316-B aligning the crankshaft drive gear timing mark with the camshaft drive gear timing mark.

NOTE: The gear may be heated to 300-350°F (149-260°C) for ease of installation. Heat it in an oven. Do not use a torch.

19. Remove all old gasket material from the front cover, engine block, oil pan sealing surfaces and water pump surfaces.

20. Coat the new front oil seal with Lubriplate® or equivalent grease.

21. The new seal must be installed using a seal installation tool, Ford part no. T83T-6700-A or an arbor press. When the seal bottoms out on the front cover surface, it is installed at the proper depth.

22. Install alignment dowels into the engine block to align the front cover and gaskets. These can be made out of round stock. Apply a gasket sealer to the engine block sealing surfaces, then install the gaskets on the block.

23. Apply a 1/8 in. (3mm) bead of RTV sealer on the front of the engine block. Apply a 1/4 in. (6mm) bead of RTV sealer on the oil pan.

24. Install the front cover immediately after applying RTV sealer. The sealer will begin to cure and lose its effectiveness unless the cover is installed quickly.

25. Install the water pump gasket on the engine front cover. Apply RTV sealer to the 4 water pump bolts illustrated. Install the water pump and hand tighten all bolts.

WARNING

The 2 top water pump bolts must be no more than 1 1/4 in. (31.75mm) long bolts any longer will interfere with (hit) the engine drive gears.

26. Torque the water pump bolts to 19 ft. lbs. (26 Nm). Torque the front cover bolts to specifications according to bolt size (see Torque Specifications chart).

27. Install the injection pump adaptor and injection pump.

28. Install the heater hose fitting in the pump using pipe sealant, and connect the heater hose to the water pump.

29. Raise the vehicle and safely support it with jackstands.

30. Lubricate the front of the crankshaft with clean oil. Apply RTV sealant to the engine side of the retaining bolt washer to prevent oil seepage past the keyway. Install the crankshaft vibration damper using Ford Special tools T83T-6316B. Torque the damper-to-crankshaft bolt to 90 ft. lbs. (122 Nm).

31. Install the fan and fan clutch assembly.

NOTE: The nut is a left hand thread; install by turning the nut clockwise.

32. Install the radiator fan shroud halves.

33. Install the air cleaner.

34. Connect both battery ground cables.

35. Fill the cooling system.

Camshaft

REMOVAL AND INSTALLATION

7.3L (VIN C, F, K, and M) Diesel Engine

NOTE: Ford recommends removing the Diesel engine from the vehicle for camshaft removal.

1. Remove the intake manifold and valley pan, if equipped.

2. Remove the rocker covers, and either remove the rocker arm shafts or loosen the rockers on their pivots

and remove the pushrods. The pushrods must be reinstalled in their original positions.

3. Remove the valve lifters in sequence with a magnet. They must be replaced in their original positions.

4. Remove the timing gear cover, timing gear and sprockets.

NOTE: A camshaft removal tool, Ford part no. T65L-6250-A and adaptor 14-0314, or equivalents, are needed to remove the Diesel camshaft.

To install:

5. Coat the camshaft with oil liberally before installing it. Slide the camshaft into the engine very carefully so as not to scratch the bearing bores with the camshaft lobes. Install the camshaft thrust plate and tighten the attaching screws to 9-12 ft. lbs. the attaching screws to 12-16 Nm. Measure the camshaft (12-16 Nm). Measure the camshaft end-play. If the end-play is more than 0.009 in. (0.228mm), replace the thrust plate. Assemble the remaining components in the reverse order of removal.

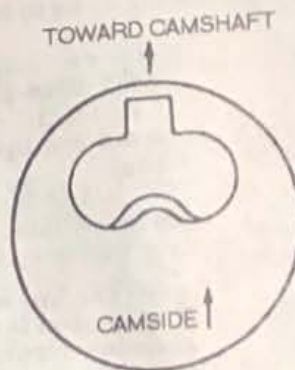
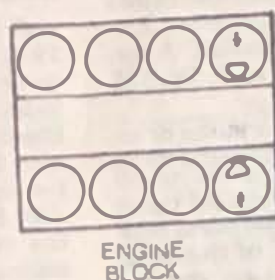
6. Install the timing gear and and front cover.

7. Install the valve lifters. They must be replaced in their original positions.

8. Install the pushrods, the rocker arms and the rocker arm covers.

9. Install the intake manifold and valley pan, if equipped.

Piston and Connecting Rod POSITIONING



Piston orientation — 7.3L (VIN C, F, K, and M) Diesel engine

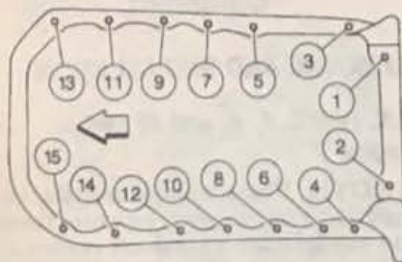
ENGINE LUBRICATION

Oil Pan

REMOVAL AND INSTALLATION

4.2L (VIN 2) Engine

1. Raise and safely support the front of the vehicle on jackstands.
2. Remove the oil pan plug and drain the engine oil.



Tighten the oil pan-to-engine block mounting bolts in the sequence shown — 4.2L (VIN 2) engines

3. Remove the 2 front wheel driveshafts and joints, if so equipped.

4. Remove the front differential from the vehicle.

5. Remove the front differential support.

6. Remove the 3 oil pan-to-transmission bolts.

7. Remove the 15 oil pan-to-cylinder block mounting bolts, then lower the oil pan.

To install:

NOTE: If the oil pan is not installed within 15 minutes, remove the sealer and reapply.

8. Temporarily install 2 locator dowels in 2 of the oil pan-to-engine block corner mounting bolt holes.

9. Clean and apply sealant to the rear main bearing cap, the oil pan mating surface, the front cover mounting area, the front cover-to-engine block joints, then install the oil pan rear seal. Make certain to use Silicone Gasket and Sealant F6AZ-19562-A or equivalent for the sealant.

10. Position the oil pan, then install 13 of the oil pan mounting bolts loosely.

11. Remove the 2 locator dowels and install the remaining 2 oil pan-to-engine block bolts.

12. Tighten the 15 oil pan mounting bolts, in the sequence shown, to

36-44 inch lbs. (4-5 Nm), then retighten the bolts to 80-106 inch lbs. (9-12 Nm).

13. Install the oil pan-to-transmission bolts to 28-38 ft. lbs. (38-51 Nm).

14. Install the oil pan drain plug to 16-22 ft. lbs. (22-30 Nm).

15. Install the front differential and front differential support.

16. Install the front driveshafts and joints.

17. Lower the vehicle to the ground.

18. Fill the engine with the correct type and amount of engine oil.

4.6L Engines (VIN W and VN 5)

1. Raise and safely support the vehicle on jackstands.

2. Remove the front axle housing from the vehicle.

3. Drain the engine oil.

4. Remove the 16 oil pan-to-engine block bolts.

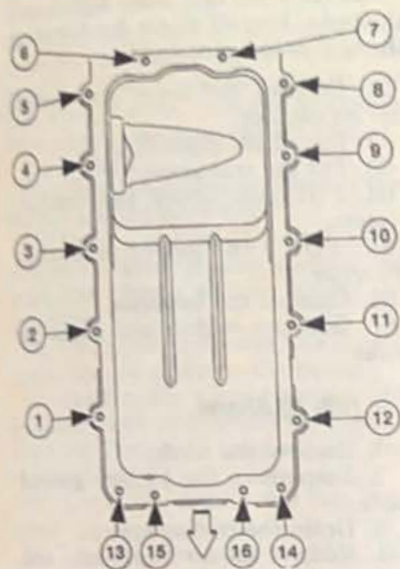
5. Remove the oil pan and old oil pan gasket.

To install:

6. Clean the oil pan and engine block mating surfaces of oil and old gasket material.

7. Install the new oil pan gasket and the oil pan, then install the 16 oil pan-to-engine block bolts loosely.

NOTE: Make sure to tighten the oil pan bolts in 3 steps.



Tighten the oil pan-to-engine block bolts in the steps following the sequence shown — U.S. engines (VIN W and VIN G)

8. Tighten the oil pan-to-engine bolts in the sequence shown, in the following 3 steps:

- Step 1 — 18 inch lbs. (2 Nm).
- Step 2 — 15 ft. lbs. (20 Nm).
- Step 3 — tighten an additional 60 degrees (one hex head flat of a bolt).

9. Install the oil drain plug.

10. Install the front axle housing.

11. Lower the vehicle.

12. Fill the engine with the correct amount and type of engine oil.

4.9L (VIN Y and Z) Engine

- Drain the crankcase.
- Drain the cooling system.
- Remove the upper intake manifold and throttle body.
- Remove the starter.
- Remove the engine front support insulator to support bracket nuts and washers on both supports. Raise the front of the engine with a transmission jack and wood block and place 1 in. (25mm) thick wood blocks between the front support insulators and support brackets. Lower the engine and remove the transmission jack.
- Remove the oil pan attaching bolts and lower the pan to the crossmember. Remove the 2 oil pump inlet tube and screw assembly bolts and

drop the assembly in the pan. Remove the oil pan. Remove the oil pump inlet tube attaching bolts. Remove the inlet tube and screen assembly from the oil pump and leave it in the bottom of the oil pan. Remove the oil pan gaskets. Remove the inlet tube and screen from the oil pan.

To install:

7. Clean the gasket surfaces of the oil pump, oil pan and cylinder block. Remove the rear main bearing cap to oil pan seal and cylinder front cover to oil pan seal. Clean the seal grooves.

8. Apply oil-resistant sealer in the cavities between the bearing cap and cylinder block. Install a new seal in the rear main bearing cap and apply a bead of oil-resistant sealer to the tapered ends of the seal.

9. Install new side gaskets on the oil pan with oil-resistant sealer. Position a new oil pan to cylinder front cover seal on the oil pan.

10. Clean the inlet tube and screen assembly and place it in the oil pan.

11. Position the oil pan under the engine. Install the inlet tube and screen assembly on the oil pump with a new gasket. Tighten the screws to 5–7 ft. lbs. (6.8–9.5 Nm). Position the oil pan against the cylinder block and install the attaching bolts. Tighten the bolts in sequence to 10–12 ft. lbs. (14–16 Nm).

12. Raise the engine with a transmission jack and remove the wood blocks from the engine front supports. Lower the engine until the front support insulators are positioned on the support brackets. Install the washers and nuts on the insulator studs and tighten the nuts.

13. Install the starter and connect the starter cable.

14. Install the manifold and throttle body.

15. Fill the crankcase and cooling system.

16. Start the engine and check for coolant and oil leaks.

5.0L (VIN N) and 5.8L (VIN H and R) Engines

- Drain the cooling system.
- Remove the bolts attaching the fan shroud to the radiator and position the shroud over the fan.
- Remove the upper intake manifold and throttle body.
- Remove the nuts and lockwashers attaching the engine support insulators to the chassis bracket.
- If equipped with an automatic transmission, disconnect the oil

cooler line at the left side of the radiator.

6. Remove the exhaust system.

7. Raise the engine and place wood blocks under the engine supports.

8. Drain the crankcase.

9. Support the transmission with a floor jack and remove the transmission crossmember.

10. Remove the oil pan attaching bolts and lower the oil pan onto the crossmember.

11. Remove the 2 bolts attaching the oil pump pick-up tube to the oil pump. Remove nut attaching oil pump pick-up tube to the number 3 main bearing cap stud. Lower the pick-up tube and screen into the oil pan.

12. Remove the oil pan from the vehicle.

To install:

13. Clean the oil pan, inlet tube and gasket surfaces. Inspect the gasket sealing surface for damages and distortion due to overtightening of the bolts. Repair and straighten as required.

14. Position a new oil pan gasket and seal to the cylinder block.

15. Position the oil pick-up tube and screen to the oil pump, and install the lower attaching bolt and gasket loosely. Install nut attaching to number 3 main bearing cap stud.

16. Place the oil pan on the crossmember. Install the upper pick-up tube bolt. Tighten the pick-up tube bolts.

17. Position the oil pan to the cylinder block and install the attaching bolts. Tighten to 10–12 ft. lbs. (14–16 Nm).

18. Install the transmission crossmember.

19. Raise the engine and remove the blocks under the engine supports. Bolt the engine to the supports.

20. Install the exhaust system.

21. If equipped with an automatic transmission, connect the oil cooler line at the left side of the radiator.

22. Install the nuts and lockwashers attaching the engine support insulators to the chassis bracket.

23. Install the upper intake manifold and throttle body.

24. Install the fan shroud.

25. Fill the crankcase.

26. Fill and bleed the cooling system.

7.3L (VIN C, F, K, and M) Diesel Engine

- Disconnect both battery ground cables.

5 FORD MOTOR CO. BRONCO/E-SERIES VAN/EXPEDITION

2. Remove the oil dipstick.
3. Remove the transmission oil dipstick.
4. Remove the air cleaner and cover the intake opening.
5. Remove the fan and fan clutch.

NOTE: The fan uses left hand threads. Remove them by turning them clockwise.

6. Drain the cooling system.
7. Disconnect the lower radiator hose.
8. Disconnect the power steering return hose and plug the line and pump.
9. Disconnect the alternator wiring harness.
10. Disconnect the fuel line heater connector from the alternator.
11. Raise and support the front end on jackstands.
12. If equipped with automatic transmission, disconnect the transmission cooler lines at the radiator and plug them.
13. Disconnect and plug the fuel pump inlet line.
14. Drain the crankcase and remove the oil filter.
15. Remove the oil filler tube.
16. Disconnect the exhaust pipes at the manifolds.
17. Disconnect the muffler inlet pipe from the muffler and remove the pipe.
18. Remove the upper inlet mounting stud from the right exhaust manifold.
19. Unbolt the engine from the No. 1 crossmember.
20. Lower the vehicle.
21. Install lifting brackets on the front of the engine.
22. Raise the engine until the transmission contact the body.
23. Install wood blocks—2 1/4 in. (70mm) on the left side; 2 in. (50mm) on the right side—between the engine insulators and crossmember.
24. Lower the engine onto the blocks.
25. Raise and support the front end on jackstands.
26. Remove the flywheel inspection plate.
27. Position fuel pump inlet line No. 1 rearward of the crossmember and position the oil cooler lines out of the way.
28. Remove the oil pan bolts.
29. Lower the oil pan.

NOTE: The oil pan is sealed to the crankcase with RTV silicone sealant in place of a gasket. It may be necessary to separate the pan from the crankcase with a utility knife.

NOTE: The crankshaft may have to be turned to allow the pan to clear the crankshaft throws.

30. Clean the pan and crankcase mating surfaces thoroughly.

To install:

31. Apply a 1/8 in. (3mm) bead of RTV silicone sealant to the pan mating surfaces, and a 1/4 in. (6mm) bead on the front and rear covers and in the corners; you have 15 minutes within which to install the pan!
32. Install locating dowels into position.
33. Position the pan on the engine and install the pan bolts loosely.
34. Remove the dowels.
35. Torque the pan bolts to 7 ft. lbs. (9.5 Nm) for 1/4 in.-20 bolts; 14 ft. lbs. (19 Nm) for 1/2 in.-18 bolts; 24 ft. lbs. (33 Nm) for 3/8 in.-16 bolts.
36. Install the flywheel inspection cover.
37. Lower the truss.
38. Raise the engine and remove the wood blocks.
39. Lower the engine onto the crossmember and remove the lifting brackets.
40. Raise and support the front end on jackstands.
41. Torque the engine-to-crossmember nut to 70 ft. lbs. (95 Nm).
42. Install the upper inlet pipe mounting stud.
43. Install the inlet pipe, using a new gas et.
44. Install the transmission oil filler tube, using a new gasket.
45. Install the oil pan drain plug.
46. Install a new oil filter.
47. Connect the fuel pump inlet line. Make sure the clip is installed on the crossmember.
48. Connect the transmission cooler lines.
49. Lower the vehicle.
50. Connect all wiring.
51. Connect the power steering return line.
52. Connect the lower radiator hose.
53. Install the fan and fan clutch.

NOTE: The fan uses left hand threads. Install them by turning them counterclockwise.

54. Remove the cover and install the air cleaner.
55. Install the dipsticks.
56. Fill the crankcase.
57. Fill and bleed the cooling system.
58. Fill the power steering reservoir.
59. Connect the batteries.

60. Run the engine and check for leaks.

NOTE: The fan uses left hand threads. Install them by turning them counterclockwise.

61. Remove the cover and install the air cleaner.
62. Install the dipsticks.
63. Fill the crankcase.
64. Fill and bleed the cooling system.
65. Fill the power steering reservoir.
66. Connect the batteries.
67. Run the engine and check for leaks.

7.5L (VIN G) Engine

1. Remove the hood.
2. Disconnect the battery ground cable.
3. Drain the cooling system.
4. Remove the air intake tube and air cleaner assembly.
5. Disconnect the throttle linkage at the throttle body.
6. Disconnect the power brake vacuum line at the manifold.
7. Disconnect the fuel lines at the fuel rail.
8. Disconnect the air tubes at the throttle body.
9. Remove the radiator.
10. Remove the power steering pump and position it out of the way without disconnecting the lines.
11. Remove the oil dipstick tube. On motor home chassis, remove the oil filler tube.
12. Remove the front engine mount through-bolts.
13. Position the air conditioner refrigerant hoses so they are clear of the firewall. If necessary, discharge the system and remove the compressor.
14. Remove the upper intake manifold and throttle body.
15. Drain the crankcase. Remove the oil filter.
16. Disconnect the exhaust pipe at the manifolds.
17. Disconnect the transmission linkage at the transmission.
18. Remove the driveshaft(s).
19. Remove the transmission fill tube.
20. Raise the engine with a jack placed under the crankshaft damper and a block of wood to act as a cushion. Raise the engine until the transmission contacts the underside of the floor. Place wood blocks under the engine supports. The engine must remain centralized at a point at least 4 in. (102mm) above the mounts, to remove the oil pan!

21. Remove the oil pan attaching screws and lower the oil pan onto the crossmember. Remove the 2 bolts attaching the oil pump pick-up tube to the oil pump. Lower the assembly from the oil pump. Leave it on the bottom of the oil pan. Remove the oil pan and gaskets. Remove the inlet tube and screen from the oil pan.

To install:

22. Clean the gasket surfaces of the oil pan and cylinder block.

23. Apply a coating of gasket adhesive on the block mating surface and stick the 1-piece silicone gasket on the block.

24. Clean the inlet tube and screen assembly and place on the pump.

25. Position the oil pan against the cylinder block and install the retaining bolts. Torque all bolts to 10 ft. lbs. (14 Nm).

26. Lower the engine and bolt it in place.

27. Install the transmission fill tube.

28. Install the driveshaft(s).

29. Connect the transmission linkage at the transmission.

30. Connect the exhaust pipe at the manifolds.

31. Install the oil filter.

32. Install the upper intake manifold and throttle body.

33. Install the compressor or reposition the hoses.

34. Install the oil dipstick tube. On motor home chassis, install the oil filter tube.

35. Install the power steering pump.

36. Install the radiator.

37. Connect the air tubes at the throttle body.

38. Connect the fuel lines at the fuel rail.

39. Connect the power brake vacuum line at the manifold.

40. Connect the throttle linkage at the throttle body.

41. Install the air intake tube and air cleaner assembly.

42. Fill and bleed the cooling system.

43. Fill the crankcase.

44. Connect the battery ground cable.

45. Install the hood.

2. Drain the engine oil and dispose.

3. Remove the oil filter.

4. Remove the 6 oil pump bolts, then remove the oil pump drive gear, the oil pump driven gear, the oil pump O-ring and the oil pump itself. Discard the used oil pump O-ring.

5. Inspect the oil pump components for damage or excessive wear.

6. Check the oil pump face for warpage with a flat edge ruler. The face cannot exhibit more than 0.00157 in. (0.04mm) of distortion.

7. Remove the plug over the oil pressure relief valve.

8. Remove the oil pressure relief valve ball and spring, then clean the parts.

To install:

NOTE: Lubricate the parts with clean engine oil before assembly.

9. Assemble the oil pressure relief valve ball and spring with a new plug.

10. Install the oil pump, along with a new O-ring, the oil pump driven gear and the drive gear. Install and tighten the 6 oil pump mounting bolts to the torque value specifications indicated in the illustration.

11. Apply a film of clean engine oil to the rubber O-ring on the new filter, then install the filter onto the filter mount.

12. Install the oil pan drain plug.

13. Lower the vehicle.

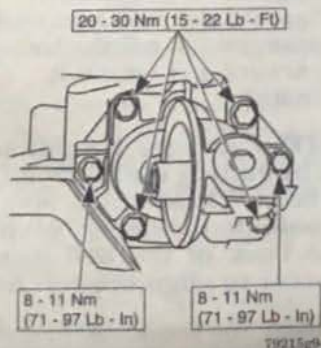
14. Fill the engine with the correct amount and type of new engine oil.

15. Start the engine and make certain that the oil light on the instrument panel extinguishes within 6-8 seconds after the engine starts.

4.6L Engines (VIN W and VIN 6)

1. Remove the timing chain.

2. Remove the oil pan.



Tighten the oil pump mounting bolts to the specifications shown—4.2L (VIN 2) engines

3. Remove the 3 oil pump screen and cover bolts, then remove the screen and cover.

4. Remove the oil pump screen and cover spacer.

5. Remove the 4 oil pump mounting bolts, then remove the oil pump from the engine.

To install:

6. Clean and inspect the mating surfaces.

7. Install the oil pump and loosely install the 4 oil pump mounting bolts. Tighten the 4 oil pump bolts in the sequence shown to 71-107 inch lbs. (8-12 Nm).

8. Install the oil pump screen and cover spacer to 15-22 ft. lbs. (20-30 Nm).

9. Install the oil pump screen and cover, then install the 3 oil pump screen and cover bolts. Tighten the bolts near the oil pick-up screen to 15-22 ft. lbs. (20-30 Nm) and the bolts at the opposite end of the pick-up to 70-106 inch lbs. (8-12 Nm).

10. Install the timing chains, then install the oil pan.

7.3L (VIN C, F, K, and M) Diesel Engine

1. Remove the oil pan.

2. Remove the oil pick-up tube from the pump.

3. Unbolt and remove the oil pump.

To install:

4. Assemble the pick-up tube and pump. Use a new gasket.

5. Install the oil pump and torque the bolts to 14 ft. lbs. (19 Nm).

4.9L (VIN Y and Z), 5.0L (VIN N), 5.8L (VIN H and R) and 7.5L (VIN G) Engines

1. Remove the oil pan.

2. Remove the oil pump inlet tube and screen assembly.

3. Remove the oil pump attaching bolts and remove the oil pump gasket and intermediate driveshaft.

To install:

4. Before installing the oil pump, prime it by filling the inlet and outlet port with oil and rotating the shaft of the pump to distribute it.

5. Position the intermediate driveshaft into the distributor socket.

6. Position the new gasket on the pump body and insert the intermediate driveshaft into the pump body.

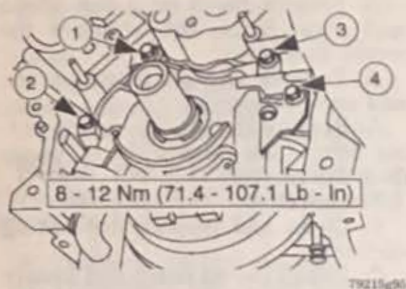
7. Install the pump and intermediate driveshaft as an assembly. Do not force the pump if it does not seal readily. The driveshaft may be misaligned with the distributor shaft. To

Oil Pump

REMOVAL AND INSTALLATION

4.2L (VIN 2) Engine

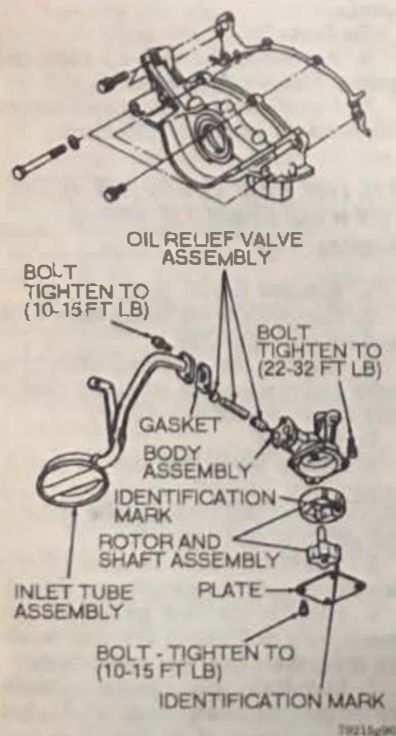
1. Raise and support the front of the vehicle safely on jackstands.



Tighten the mounting bolts to 71-107 inch lbs. (8-12 Nm) in the sequence shown—4.6L engines (VIN W and VIN 6)

align it, rotate the intermediate driveshaft into a new position.

8. Install the oil pump attaching bolts and torque them to 12-15 ft. lbs. (16-20 Nm) on the inline sixes and to 20-25 ft. lbs. (27-34 Nm) on the V8s.



Oil pump assembly — 5.0L (VIN N) and 5.8L (VIN H and R) engines

TRANSMISSION

Manual Transmission Assembly

REMOVAL AND INSTALLATION

CAUTION

The clutch driven disc contains asbestos, which has been determined to be a cancer causing agent. Never clean clutch surfaces with compressed air! Avoid inhaling any dust from any clutch surface! When cleaning clutch surfaces, use a commercially available brake cleaning fluid.

NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 10 miles (16 km) or more to relearn the strategy.

Borg-Warner T-18

2-Wheel Drive Models

1. Remove the rubber boot, floor mat, and the body floor pan cover.
2. Remove the gearshift lever, shift ball and boot as an assembly.
3. Raise the vehicle and support it with jackstands.
4. Drain the transmission.
5. Remove the driveshaft.
6. Disconnect the speedometer cable.
7. Remove the crossmember-to-transmission bolts.
8. Secure the transmission to a transmission jack.
9. Remove the crossmember.
10. Remove the 4 transmission-to-bell housing bolts, roll the transmission rearward and remove it.

To install:

NOTE: Fabricate 2 guide pins, made by cutting the heads off of 2 long bolts. These guide pins are inserted into the upper bolt holes in the back of the bell housing and serve to align the bolt holes.

11. Raise the transmission and roll it forward using the guide pins to align the bolt holes. Turn the output shaft by hand to align the input shaft splines with the clutch.

12. Install the 2 lower bolts and snug them down.

13. Remove the guide pins and install the 2 remaining bolts. Torque all 4 bolts to 50 ft. lbs. (68 Nm).

14. Install the crossmember. Crossmember-to-frame bolt torque is 55 ft. lbs. (75 Nm).

15. Remove the transmission jack.

16. Install the Crossmember-to-transmission bolts. Torque the bolts to 50 ft. lbs. (68 Nm).

17. Connect the speedometer cable.

18. Install the driveshaft.

19. Install the drain plug and fill the transmission. Drain plug torque is 50 ft. lbs. (68 Nm).

20. Lower the vehicle.

21. Install the gearshift lever, shift ball and boot as an assembly.

22. Install the body floor pan cover, floor mat, and the rubber boot.

4-Wheel Drive Models

1. Remove the rubber boot, floor mat, and the body floor pan cover. Remove the gearshift lever. Remove the weather pad.

2. Remove the transfer case shift lever, shift ball and boot as an assembly.

3. Disconnect the back-up light switch at the rear of the gearshift housing cover.

4. Raise the vehicle and support it with jackstands. Remove the drain and fill plugs and drain the lubricant.

5. Position a transmission jack under the transfer case and disconnect the speedometer cable.

6. Matchmark the flanges and disconnect the rear driveshaft from the transfer case. Wire it up and out of the way.

7. Matchmark and disconnect the front driveshaft at the transfer case. Wire it up and out of the way.

8. Remove the shift link from the transfer case.

9. Unbolt the transfer case from the transmission (6 bolts) and lower the transfer case from the vehicle.

10. Position the transmission jack under the transmission.

11. Remove the 8 rear transmission support-to-transmission bolts.

12. Remove the rear transmission support.

13. Remove the 4 transmission-to-clutch housing attaching bolts.

14. Move the transmission to the rear until the input shaft clears the flywheel housing and lower the transmission.

To install:

NOTE: Fabricate 2 guide pins, made by cutting the heads off of 2 long bolts. These guide pins are inserted into the upper bolt holes in the back of the bell housing and serve to align the bolt holes.

15. Before installing the transmission, apply a light film of grease to the inner hub surface of the clutch release bearing, the release lever fulcrum and the front bearing retainer of the transmission. Do not apply excessive grease because it will fly off onto the clutch disc.

16. Install the transmission in the reverse order of removal. It may be necessary to turn the output shaft with the transmission in gear to align the input shaft splines with the splines in the clutch disc. Fill the transmission with SAE 80W/90 lubricant if it was drained. The transfer case is filled with Dexron®11 ATF. Observe the following torque specifications:

- Back-up light switch — 25 ft. lbs. (34 Nm)
- Transmission-to-clutch housing bolts — 65 ft. lbs. (88 Nm)
- Transfer case-to-transmission — 40 ft. lbs. (54 Nm)
- Drain plug — 50 ft. lbs. (68 Nm)
- Fill plug — 50 ft. lbs. (68 Nm)
- Transmission to rear support — 80 ft. lbs. (109 Nm)
- Rear support-to-frame — 55 ft. lbs. (75 Nm)

M50D 5-Speed

Except 1997 F-150 and Expedition Models

1. Raise and support the vehicle safely. Prop the clutch pedal in the full up position with a block of wood.

2. Matchmark the driveshaft-to-flange relation.

3. Disconnect the driveshaft at the rear axle and slide it off of the transmission output shaft. Lubricant will leak out of the transmission so be prepared to catch it, or plug the opening with rags or a seal installation tool.

4. Disconnect the speedometer cable at the transmission.

5. Disconnect the shift rods from the shift levers.

6. Remove the shift control from the extension housing and transmission case.

7. On 4-wheel drive models, remove the transfer case.

8. Remove the extension housing-to-rear support bolts.

9. Take up the weight of the transmission with a transmission jack. Chain the transmission to the jack.

10. Raise the transmission just enough to take the weight off of the No. 3 crossmember.

11. Unbolt the crossmember from the frame rails and remove it.

12. Place a jackstand under the rear of the engine at the bell housing.

13. Lower the jack and allow the jackstand to take the weight of the engine. The engine should be angled slightly downward to allow the transmission to roll backward.

14. Remove the transmission-to bell housing bolts.

15. Roll the jack rearward until the input shaft clears the bell housing. Lower the jack and remove the transmission.

WARNING

Do not depress the clutch pedal with the transmission removed.

To install:

16. Clean all machined mating surfaces thoroughly.

17. Install a guide pin in each lower bolt hole. Position the spacer plate on the guide pins.

18. Raise the transmission and start the input shaft through the clutch release bearing.

19. Align the input shaft splines with the clutch disc splines. Roll the transmission forward so the input shaft will enter the clutch disc. If the shaft binds in the release bearing, work the release arm back and forth.

20. Once the transmission is all the way in, install the 2 upper retaining bolts and washers and remove the lower guide pins. Install the lower bolts. Torque the bolts to 50 ft. lbs. (68 Nm).

21. Raise the transmission just enough to allow installation of the No.3 crossmember.

22. Install the crossmember on the frame rails. Torque the bolts to 80 ft. lbs. (109 Nm).

23. Lower the transmission onto the crossmember and install the nuts. Torque the nuts to 70 ft. lbs. (95 Nm).

24. Remove the transmission jack.

25. Install the transfer case.

26. Install the shift control on the extension housing and transmission case.

27. Connect the shift rods at the shift levers.

28. Connect the speedometer cable at the transmission.

29. Slide the driveshaft onto the output shaft and connect the driveshaft at the rear axle, aligning the matchmarks.

1997 F-150 and Expedition Models

1. Disconnect the negative battery cable.

2. Place the transmission in Neutral.

3. Remove the gearshift lever, the outer gearshift lever boot and the inner gearshift lever boot.

4. Detach the transmission harness electrical connector by removing the retaining bolt and separating the two halves.

5. Raise and safely support the vehicle on jackstands.

6. Drain the transmission fluid.

7. Matchmark the rear driveshaft to the differential mounting flange and, on 4-wheel drive versions, to the transmission housing, then remove the 4 attaching bolts. Remove the driveshaft from the vehicle.

8. On 4-wheel drive models, remove the transfer case.

9. Use Clutch Coupling Tool T88T-70522-A, or equivalent, to disconnect the clutch hydraulic line.

10. Remove the starter motor.

11. Detach the 2 heated oxygen sensor electrical connectors.

12. Position a transmission jack, or equivalent, under the transmission. Secure the transmission to the jack with a strap.

13. Remove the 2 transmission mount nuts.

14. Remove the 2 heat shield mounting bolts (one on each side).

15. Remove the 6 rear crossmember mounting bolts, then remove the crossmember from the vehicle.

16. Remove the rear transmission mount from the vehicle frame.

17. Remove the exhaust pipe bracket.

18. Remove the fuel line bracket.

19. On 4.2L (VIN 2) engines, remove the 3 oil pan-to-transmission bolts.

20. Remove the 6 engine-to-transmission bolts.

21. Remove the 4 exhaust pipe-to-exhaust manifold nuts (two on each side) and position the exhaust pipe aside.

22. Slowly and carefully lower the transmission from the vehicle.

To install:

23. Raise the transmission slowly and carefully up into the vehicle.

24. Position the exhaust pipe onto the exhaust manifold, then install the 4 mounting nuts to 25-34 ft. lbs. (34-46 Nm).

25. Install the 6 engine-to-transmission bolts and tighten to 30-41 ft. lbs. (40-55 Nm).

Clutch Assembly

26. On 4.2L (VIN 2) engines, install the 3 oil pan-to-transmission bolts to 28–38 ft. lbs. (38–51 Nm).

27. Install the fuel line bracket and tighten the mounting nut to 13–17 ft. lbs. (17–23 Nm).

28. Install the exhaust bracket and tighten the 2 mounting nuts to 25–33 ft. lbs. (34–46 Nm).

29. Install the transmission mount and tighten the 2 mounting bolts to 64–81 ft. lbs. (87–110 Nm).

30. Install the rear crossmember into the vehicle. Tighten the 6 crossmember mounting bolts to 39–53 ft. lbs. (53–72 Nm).

31. Install the 2 heat shield bolts, then install the 2 transmission-to-transmission mount nuts to 64–81 ft. lbs. (87–110 Nm).

32. Lower the transmission jack slowly.

33. Attach the 2 heated oxygen sensor electrical connectors, then install the starter motor.

34. For vehicles equipped with 4-wheel drive, install the transfer case.

35. Install the rear driveshaft. Mount the driveshaft to the differential flange so that the matchmarks align, then tighten the 4 mounting bolts to 65–87 ft. lbs. (88–119 Nm).

36. Connect the hydraulic clutch line. The clutch system must be bled upon completion of transmission installation.

37. Fill the transmission with transmission fluid until it reaches the bottom of the fill port and install the case plug. Make sure to use MERCON Multi-Purpose Automatic Transmission Fluid XT-2-QDX or DDX, or equivalent.

38. Lower the vehicle.

39. Install the shift lever.

40. Attach the transmission harness electrical connector.

41. Attach the negative battery cable.

ZF S5-42 5-Speed

1. Place the transmission in neutral.

2. Remove the carpet or floor mat.

3. Remove the ball from the shift lever.

4. Remove the boot and bezel assembly from the floor.

5. Remove the 2 bolts and disengage the upper shift lever from the lower shift lever.

6. Raise and support the vehicle safely.

7. Disconnect the speedometer cable.

8. Disconnect the back-up switch wire.

9. Place a drain pan under the case and drain the case through the drain plug.

10. Position a transmission jack under the case and safety-chain the case to the jack.

11. Remove the driveshaft.

12. Disconnect the clutch linkage.

13. On 4-wheel drive models, remove the transfer case.

14. Remove the transmission rear insulator and lower retainer.

15. Unbolt and remove the crossmember.

16. Remove the transmission-to-engine block bolts.

17. Roll the transmission rearward until the input shaft clears, lower the jack and remove the transmission.

To install:

18. Install 2 guide studs into the lower bolt holes.

19. Raise the transmission until the input shaft splines are aligned with the clutch disc splines. The clutch release bearing and hub must be properly positioned in the release lever fork.

20. Roll the transmission forward and into position on the front case.

21. Install the bolts and torque them to 50 ft. lbs. (68 Nm). Remove the guide studs and install and tighten the 2 remaining bolts.

22. Install the crossmember and torque the bolts to 55 ft. lbs. (75 Nm).

23. Install the transmission rear insulator and lower retainer. Torque the bolts to 60 ft. lbs. (81 Nm).

24. On 4-wheel drive models, install the transfer case.

25. Connect the clutch linkage.

26. Install the driveshaft.

27. Remove the transmission jack.

28. Fill the transmission.

29. Connect the back-up switch wire.

30. Connect the speedometer cable.

31. Lower the van.

32. Install the boot and bezel assembly.

33. Connect the upper shift to from the lower shift lever. Tighten the bolts to 20 ft. lbs. (27 Nm).

34. Install the carpet or floor mat.

35. Install the ball from the shift lever.

REMOVAL AND INSTALLATION

CAUTION

The clutch driven disc contains asbestos, which has been determined to be a cancer causing agent. Never clean clutch surfaces with compressed air! Avoid inhaling any dust from any clutch surface! When cleaning clutch surfaces, use a commercially available brake cleaning fluid.

Except 1997 F-150 and Expedition Models

1. Raise and support the vehicle safely.

2. If equipped with an externally mounted slave cylinder, remove the clutch slave cylinder. If equipped with an internally mounted slave cylinder, disconnect the quick-disconnect coupling with a spring coupling tool such as T88T-70522-A.

3. Remove the transmission.

4. If equipped with an internally mounted slave cylinder, remove the starter. Remove the flywheel housing attaching bolts and remove the housing. If equipped with an externally mounted slave cylinder, remove the cover and then remove the release lever and bearing from the clutch housing. To remove the release lever:

a. Remove the dust boot.

b. Push the release lever forward to compress the slave cylinder.

c. Remove the slave cylinder by prying on the steel clip to free the tangs while pulling the cylinder clear.

d. Remove the release lever by pulling it outward.

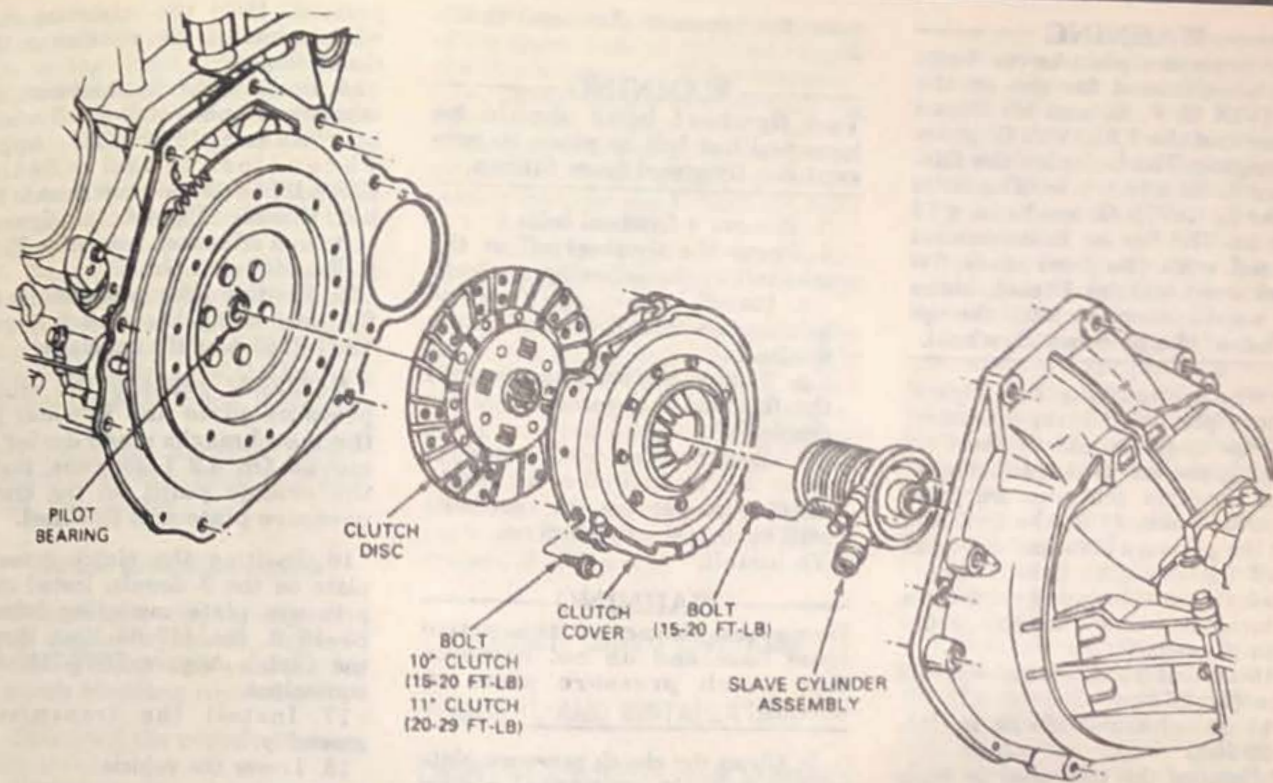
5. Mark the pressure plate and cover assembly and the flywheel so they can be reinstalled in the same relative position.

6. Loosen the pressure plate and cover attaching bolts evenly in a staggered sequence a turn at a time until the pressure plate springs are relieved of their tension. Remove the attaching bolts.

7. Remove the pressure plate and cover assembly and the clutch disc from the flywheel.

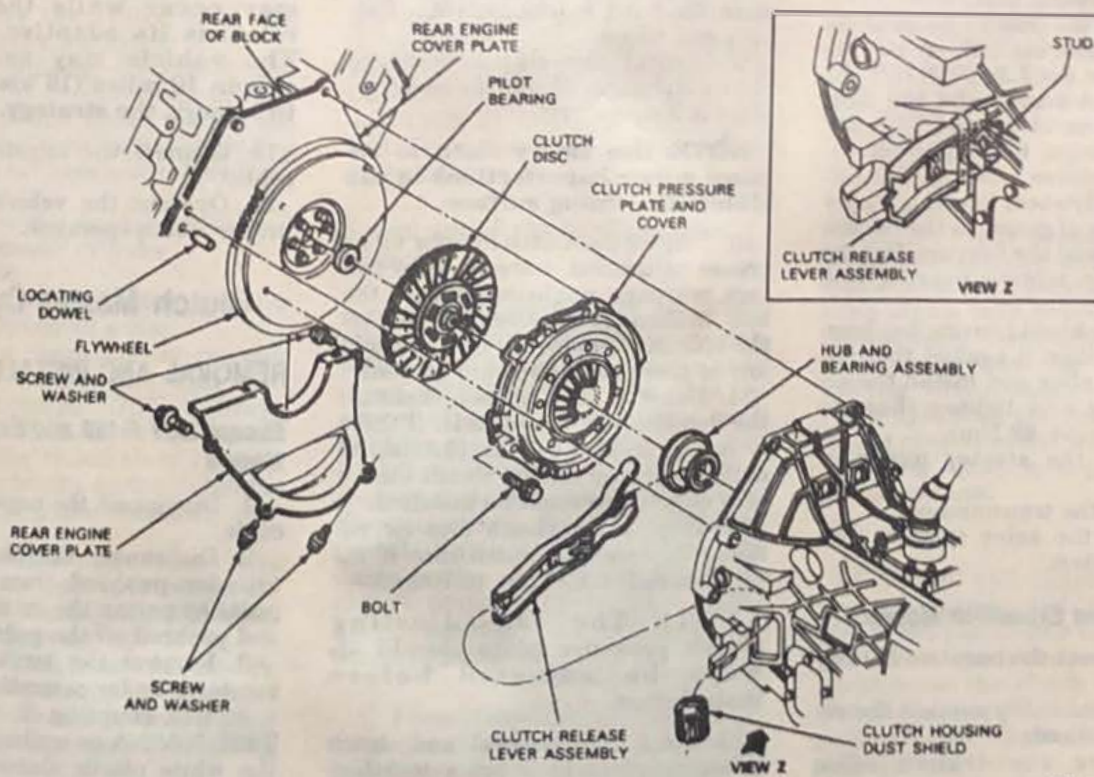
To install:

8. Position the clutch disc on the flywheel so an aligning tool can enter the clutch pilot bearing and align the disc.



TW215ga3

Clutch Installation — Bronco, F Series and E Series with 4.9L (VIN Y and Z), 5.0L (VIN N) and 5.8L (VIN H and R) engines



TW215ga4

Clutch Installation — F Series with 7.3L (VIN C, F, K, and M) Diesel and 7.5L (VIN G) engines

WARNING

New pressure plate/cover bolts have been issued for use on the 7.3L (VIN C, F, K, and M) Diesel engine and the 7.5L (VIN G) gasoline engine. The bolts for the Diesel are $\frac{7}{16}$ in. x 18 x $\frac{3}{4}$ in. The bolts for the 7.5L (VIN G) are $\frac{7}{16}$ in. x 18 x $\frac{3}{4}$ in. The $\frac{3}{4}$ in. bolts cannot be used with the dual mass flywheel used on the Diesel, since they would interfere with the operation of the primary flywheel.

9. When reinstalling the original pressure plate and cover assembly, align the assembly and flywheel according to the marks made during removal. Position the pressure plate and cover assembly on the flywheel, align the pressure plate and disc, and install the retaining bolts. Tighten the bolts in an alternating sequence a few turns at a time until the proper torque is reached:

- 10 in. and 12 in. clutch — 15–20 ft. lbs. (20–27 Nm)
- 11 in. clutch — 20–29 ft. lbs. (27–39 Nm)

10. Remove the tool used to align the clutch disc.

11. With the clutch fully released, apply a light coat of grease on the sides of the driving lugs.

12. Position the clutch release bearing and the bearing hub on the release lever. On the 7.3L (VIN C, F, K, and M) Diesel engine and the 7.5L (VIN G) engine, clean and lubricate the transmission bearing retainer. Install the release lever on the fulcrum in the flywheel housing. Apply a light coating of grease to the release lever fingers and the fulcrum. Fill the groove of the release bearing hub with grease.

13. If the flywheel housing has been removed, position it against the rear engine cover plate and install the attaching bolts and tighten them to 40–50 ft. lbs. (54–68 Nm).

14. Install the starter motor, if removed.

15. Install the transmission.

16. Install the slave cylinder and bleed the system.

1997 F-150 and Expedition Models

1. Disconnect the negative battery cable.

2. Raise and safely support the vehicle on jackstands.

3. Remove the transmission assembly.

4. If the clutch parts are to be reused, matchmark the clutch pressure plate and flywheel. Remove the 6 clutch pressure plate bolts, then re-

move the pressure plate and clutch disc.

WARNING

Two flywheel bolts should be loosened but left in place to prevent the flywheel from falling.

5. Remove 4 flywheel bolts.

6. Press the flywheel off of the crankshaft by the following method:

a. Install two of the flywheel bolts in the threaded holes in the flywheel.

b. Tighten the bolts evenly until the flywheel is pressed off of the crankshaft.

c. Remove the bolts used to press the flywheel off of the crankshaft, then remove the two bolts still holding the flywheel on.

To install:

WARNING

Do not use cleaners with a petroleum base and do not immerse the clutch pressure plate in solvent.

7. Clean the clutch pressure plate with a suitable commercial alcohol based solvent so that the surface is free from oil film.

8. Inspect the clutch pressure plate for burn marks, scoring, flatness and ridges.

9. Inspect the clutch pressure plate diaphragm fingers for wear; replace it if necessary.

NOTE: Use emery cloth to remove minor imperfections in the clutch disc lining surface.

10. Inspect the clutch disc for oil or grease saturation, worn or loose facings, warpage and loose rivets at the hub, broken springs, wear or rust on the splines. Replace the clutch disc if any of these conditions are present.

11. Using a slide caliper, measure the depth of the rivet heads. If there is not at least 0.012 in. (0.3mm) of clutch material on the clutch disc, a new clutch disc must be installed.

12. Inspect the clutch disc for runout. Replace the clutch disc if runout exceeds 0.0276 in. (0.70mm).

NOTE: The self-adjusting clutch pressure plate should always be adjusted before installation.

13. Place the flywheel and clutch pressure plate in a press together. Use an adapter and depress the clutch diaphragm fingers until the adjusting ring moves freely. Rotate the adjusting ring counterclockwise until the tension springs are com-

pressed. Hold the adjusting ring while releasing the pressure on the clutch fingers.

14. Position the flywheel onto the crankshaft and install the flywheel-to-crankshaft bolts. Apply Threadlock and Sealer E0AZ-19554-AA or equivalent to the bolt threads. Tighten the flywheel bolts in a crisscross manner to 75–85 ft. lbs. (102–115 Nm).

15. Position the clutch disc on the flywheel using the Clutch Aligner T83T-7137-A or the equivalent.

NOTE: If reusing the clutch pressure plate and flywheel use the matchmarks made during removal. On 4.2 L engines, match the orange paint on the clutch pressure plate and flywheel.

16. Position the clutch pressure plate on the 3 dowels. Install the 6 pressure plate mounting bolts to 35–46 ft. lbs. (47–63 Nm). Remove the Clutch Aligner T83T-7137-A or equivalent.

17. Install the transmission assembly.

18. Lower the vehicle.

NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 10 miles (16 km) or more to relearn the strategy.

19. Connect the negative battery cable.

20. Operate the vehicle to check proper clutch operation.

Clutch Master Cylinder

REMOVAL AND INSTALLATION

Except 1997 F-150 and Expedition Models

1. Disconnect the negative battery cable.

2. Disconnect the clutch master cylinder pushrod from the clutch pedal by prying the retainer bushing and pushrod off the pedal pin.

3. Remove the switch from the master cylinder assembly.

4. Use coupling disconnect tool T88T-70522-A or equivalent, to slide the white plastic sleeve toward the slave cylinder, then apply a light tug on the tube to disconnect the hydraulic coupling.

5. Remove the retaining bolts and the clutch master cylinder.

To install:

6. Install the pushrod through the hole in the engine compartment. Make sure it is located on the correct side of the clutch pedal. Install the master cylinder and tighten the bolts to 12 ft. lbs. (16 Nm).

7. Insert the coupling end into the slave cylinder and install the tube into the clips.

8. Replace the retainer bushing in the clutch master cylinder pushrod if worn or damaged. Install the retainer and pushrod on the clutch pedal pin. Make sure the flange of the bushing is against the pedal blade. Install the switch.

9. Connect the negative battery cable and bleed the clutch hydraulic system, if necessary.

1997 F-150 and Expedition Models

NOTE: When replacing the clutch master cylinder, remove the tubing from the vehicle for the bench bleeding procedure.

1. Disconnect the negative battery cable.

2. Disconnect the clutch master cylinder pushrod from the clutch pedal by prying the retainer bushing and pushrod off the pedal pin.

3. Remove the switch from the master cylinder assembly.

4. Use coupling disconnect tool T88T-70522-A or equivalent, to slide the white plastic sleeve toward the slave cylinder, then apply a slight tug on the tube to disconnect the hydraulic coupling.

5. Remove the retaining bolts and the clutch master cylinder.

To install:

6. Lightly clamp the clutch master cylinder reservoir in a vise.

7. Fill the clutch master cylinder reservoir to the full line with Ford High Performance DOT 3 Brake Fluid 66AZ-19542-AA or equivalent.

8. Place the clutch slave cylinder end of the hydraulic system tubing in a drain pan or waste container.

NOTE: Make sure that the clutch master cylinder reservoir remains full during the bleeding process to prevent air from entering the clutch master cylinder. Bleed the clutch master cylinder until a solid stream of brake fluid exits the quick connect coupling end of the tube.

9. Open the internal mechanism of the male quick connect coupling and depress and hold the clutch master cylinder pushrod.

10. Release the internal mechanism of the quick connect end and release the clutch master cylinder pushrod.

11. Install the pushrod through the hole in the engine compartment. Make sure it is located on the correct side of the clutch pedal. Install the master cylinder and tighten the bolts to 12 ft. lbs. (16 Nm).

12. Insert the coupling end into the slave cylinder and install the tube into the clips.

13. Replace the retainer bushing in the clutch master cylinder pushrod if worn or damaged. Install the retainer and pushrod on the clutch pedal pin. Make sure the flange of the bushing is against the pedal blade. Install the switch.

14. Connect the negative battery cable and bleed the clutch hydraulic system, if necessary.

Clutch Slave Cylinder

REMOVAL AND INSTALLATION

There are 2 types of slave cylinders used: an internally mounted (in the bell housing) and an externally mounted type. The 5.0L (VIN N), 5.8L (VIN H and R) and 7.5L (VIN G) gasoline engines and 7.3L (VIN C, F, K, and M) Diesel engines, equipped with the M50DHD transmission use the externally mounted type; the 4.2L (VIN 2), 4.6L and 4.9L (VIN Y and Z) engine uses the internally mounted type.

Except 1997 F-150 and Expedition Models

WARNING

Prior to any service on models with the externally mounted slave cylinder, that requires removal of the slave cylinder, such as transmission and/or clutch housing removal, the clutch master cylinder pushrod must be disconnected from the clutch pedal. Failure to do this may damage the slave cylinder if the clutch pedal is depressed while the slave cylinder is disconnected.

1. From inside the cab, remove the cotter pin retaining the clutch master cylinder pushrod to the clutch pedal lever. Disconnect the pushrod and remove the bushing.

2. Remove the 2 nuts retaining the clutch reservoir and master cylinder assembly to the firewall.

3. From the engine compartment, remove the clutch reservoir and master cylinder assembly from the firewall. Note here how the clutch tubing routes to the slave cylinder.

4. Push the release lever forward to compress the slave cylinder.

5. On all models with the internally mounted slave cylinder, remove the plastic clip that retains the slave cylinder to the bracket. Remove the slave cylinder.

6. On models with the externally mounted slave cylinder, the steel retaining clip is permanently attached to the slave cylinder. Remove the slave cylinder by prying on the clip to free the tangs while pulling the cylinder clear.

7. Remove the release lever by pulling it outward.

8. Remove the clutch hydraulic system from the vehicle.

To install:

9. Position the clutch pedal reservoir and master cylinder assembly into the firewall from inside the cab, and install the 2 nuts and tighten.

10. Route the clutch tubing and slave cylinder to the bell housing, taking care that the nylon lines are kept away from any hot exhaust system components.

11. Install the slave cylinder by pushing the slave cylinder pushrod into the cylinder. Engage the pushrod into the release lever and slide the slave cylinder into the bell housing lugs. Seat the cylinder into the recess in the lugs.

NOTE: When installing a new hydraulic system, notice that the slave cylinder contains a shipping strap that propositions the pushrod for installation, and also provides a bearing insert. Following installation of the new slave cylinder, the first actuation of the clutch pedal will break the shipping strap and give normal clutch action.

12. Clean the master cylinder pushrod bearing and apply a light film of SAE 30 engine oil.

13. From inside the cab, install the bushing on the clutch pedal lever. Connect the clutch master cylinder pushrod to the clutch pedal lever and install the cotter pin.

14. Check the clutch reservoir and add fluid if required. Depress the clutch pedal at least 10 times to verify smooth operation and proper clutch release.

5 FORD MOTOR CO. BRONCO/E-SERIES VAN/EXPEDITION

1997 F-150 and Expedition Models

1. Remove the transmission.

NOTE: Inspect the clutch housing for traces of fluid. If fluid is found, the clutch slave cylinder should be replaced with a new one.

2. Remove the clutch slave cylinder mounting bolts, then slide the slave cylinder off of the transmission input shaft.

3. Remove the clutch release hub and bearing, if necessary, as follows:
 - a. Push the clutch release hub and bearing against the spring.
 - b. Remove the retainer ring.
 - c. Remove the clutch release hub, bearing and spring.

To install:

4. Clean the slave cylinder.
5. Inspect the slave cylinder for the following:
 - Weak spring
 - Worn or damaged piston
 - Worn or damaged boot
 - Leaking fluid

WARNING

The clutch release hub and bearing is pre-lubricated and should not be cleaned with solvent. The clutch release hub and bearing are replaced as an assembly; do not disassemble for inspection or replacement.

6. Wipe all oil and dirt off of the clutch release hub and bearing.

7. Inspect the clutch release hub and bearing as follows:

- a. Rotate the outer race while applying pressure. If the bearing rotation is rough, replace the clutch release hub and bearing.

- b. Inspect for any surface scoring or burrs that may impede the sliding motion of the clutch release hub and bearing. Any scoring or burrs should be polished off with a fine grade of emery paper.

8. Install the clutch release hub and bearing as follows:

- a. Lubricate the clutch release hub and bearing at the sliding points with Premium Long-Life Grease XG-1-C or -K, or equivalent.

- b. Position the spring, release hub and bearing onto the clutch slave cylinder.

- c. Push the clutch release hub and the bearing against the spring.

- d. Install the retainer ring.

9. Position the slave cylinder onto the transmission input shaft, then

tighten the mounting bolts to 14-19 ft. lbs. (19-26 Nm).

10. Install the transmission.

Hydraulic Clutch System

Bleeding

Externally Mounted Slave Cylinder

1. Clean the reservoir cap and the slave cylinder connection.
2. Remove the slave cylinder from the housing.
3. Using a $\frac{3}{32}$ in. punch, drive out the pin that holds the tube in place.
4. Remove the tube from the slave cylinder and place the end of the tube in a container.
5. Hold the slave cylinder so the connector port is at the highest point, by tipping it about 30 degrees from horizontal. Fill the cylinder with DOT 3 brake fluid through the port. It may be necessary to rock the cylinder or slightly depress the pushrod to expel all the air.

WARNING

Pushing too hard on the pushrod will spurt fluid from the port!

6. When all air is expelled — no more bubble are seen — install the slave cylinder.

NOTE: Some fluid will be expelled during installation as the pushrod is depressed.

7. Remove the reservoir cap. Some fluid will run out of the tube end into the container. Pour fluid into the reservoir until a steady stream of fluid runs out of the tube and the reservoir is filled. Quickly install the diaphragm and cap. The flow should stop.

8. Connect the tube and install the pin. Check the fluid level.

9. Check the clutch operation.

Internally Mounted Slave Cylinder

Except 1997 F-150 and Expedition Models

NOTE: With the quick-disconnect coupling, no air should enter the system when the coupling is disconnected. However, if air should somehow enter the system, it must be bled.

1. Remove the reservoir cap and diaphragm. Fill the reservoir with DOT 3 brake fluid.

2. Connect a piece of rubber tubing to the slave cylinder bleed screw. Place the other end in a container.

3. Loosen the bleed screw. Gravity will force fluid from the master cylinder to flow down to the slave cylinder, forcing air out of the bleed screw. When a steady stream — no bubbles — flows out, the system is bled. Close the bleed screw.

NOTE: Check periodically to make sure the master cylinder reservoir doesn't run dry.

4. Add fluid to fill the master cylinder reservoir.

5. Fully depress the clutch pedal. Release it as quickly as possible. Pause for 2 seconds. Repeat this procedure 10 times.

6. Check the fluid level. Refill it if necessary. It should be kept full.

7. Repeat Steps 5 and 6 five more times.

8. Install the diaphragm and cap.

9. Have an assistant hold the pedal to the floor while you crack the bleed screw — not too far — just far enough to expel any trapped air. Close the bleed screw, then, release the pedal.

10. Check, and if necessary, fill the reservoir.

1997 F-150 and Expedition Models

NOTE: Be sure to keep the clutch master cylinder reservoir full of brake fluid during the bleeding process to prevent air from entering the clutch master cylinder.

1. Raise and safely support the front of the vehicle on jackstands.

NOTE: It is necessary to have the assistance of a helper to bleed this system.

2. Fill the clutch system reservoir with Ford High Performance DOT 3 Brake Fluid C6AZ-19542-AA or equivalent.

3. Have your assistant depress the clutch pedal rapidly for 5-10 strokes.

4. Wait 1-3 minutes.

5. Repeat Steps 3 and 4 three more times.

6. Loosen the bleeder screw on the transmission for the slave cylinder.

7. Have the helper fully depress the clutch pedal and hold down.

8. Tighten the bleeder screw.

9. The helper should now release the clutch pedal.

10. Apply pressure to the clutch pedal. If the clutch pedal travels more or less than 6-7 in. (153-177 mm), repeat the bleeding process.



External slave cylinder bleeding —
Bronco, F Series (Pick-Up) and E Series
(Van)

Automatic Transmission Assembly

REMOVAL AND INSTALLATION

CS Transmission

1. From in the engine compartment, remove the 2 upper converter housing-to-engine bolts.
2. Disconnect the neutral switch wire at the inline connector.
3. Remove the bolt securing the fluid filler tube to the engine cylinder head.
4. Raise and support the vehicle safely.
5. Place the drain pan under the transmission fluid pan. Starting at the rear of the pan and working toward the front, loosen the attaching bolts and allow the fluid to drain. Finally remove all of the pan attaching bolts except 2 at the front, to allow the fluid to further drain. With fluid drained, install 2 bolts on the rear side of the pan to temporarily hold it in place.
6. Remove the converter drain plug access cover from the lower end of the converter housing.
7. Remove the converter-to-flywheel attaching nuts. Place a wrench on the crankshaft pulley attaching bolt to turn the converter to gain access to the nuts.
8. With the wrench on the crankshaft pulley attaching bolt, turn the converter to gain access to the converter drain plug. Place a drain pan under the converter to catch the fluid and remove the plug. After the fluid has been drained, reinstall the plug.
9. On 2WD models, disconnect the driveshaft from the rear axle and slide shaft rearward from the transmission. Install a seal installation tool in the extension housing to prevent fluid leakage.

10. Disconnect the speedometer cable from the extension housing.

11. Disconnect the downshift and manual linkage rods from the levers at the transmission.

12. Disconnect the oil cooler lines from the transmission.

13. Remove the vacuum hose from the vacuum diaphragm unit. Remove the vacuum line retaining clip.

14. Disconnect the cable from the terminal on the starter motor. Remove the 3 attaching bolts and remove the starter motor.

15. On 4WD models remove the transfer case.

16. Remove the 2 engine rear support and insulator assembly-to-attaching bolts.

17. Remove the 2 engine rear support and insulator assembly-to-extension housing attaching bolts.

18. Remove the 6 bolts securing the No. 2 crossmember to the frame side rails.

19. Raise the transmission with a transmission jack and remove both crossmembers.

20. Secure the transmission to the jack with the safety chain.

21. Remove the remaining converter housing-to-engine attaching bolts.

22. Move the transmission away from the engine. Lower the jack and remove the converter and transmission assembly from under the vehicle.

To install:

23. Tighten the converter drain plug.

24. Position the converter on the transmission making sure the converter drive flats are fully engaged in the pump gear.

25. With the converter properly installed, place the transmission on the jack. Secure the transmission on the jack with the chain.

26. Rotate the converter until the studs and drain plug are in alignment with their holes in the flywheel.

27. Move the converter and transmission assembly forward into position, using care not to damage the flywheel and the converter pilot. The converter must rest squarely against the flywheel. This indicates that the converter pilot is not binding in the engine crankshaft.

28. Install the converter housing-to-engine attaching bolts and torque them to 65 ft. lbs. (88 Nm) for the Diesel; 50 ft. lbs. (68 Nm) for gasoline engines.

29. Remove the transmission jack safety chain from around the transmission.

30. Position the No. 2 crossmember to the frame side rails. Install and tighten the attaching bolts.

31. Install transfer case on 4WD models.

32. Position the engine rear support and insulator assembly above the crossmember. Install the rear support and insulator assembly-to-extension housing mounting bolts and tighten the bolts to 45 ft. lbs. (61 Nm).

33. Lower the transmission and remove the jack.

34. Secure the engine rear support and insulator assembly to the crossmember with the attaching bolts and tighten them to 80 ft. lbs. (109 Nm).

35. Connect the vacuum line to the vacuum diaphragm making sure the line is in the retaining clip.

36. Connect the oil cooler lines to the transmission.

37. Connect the downshift and manual linkage rods to their respective levers on the transmission.

38. Connect the speedometer cable to the extension housing.

39. Secure the starter motor in place with the attaching bolts. Connect the cable to the terminal on the starter.

40. Install a new O-ring on the lower end of the transmission filler tube and insert the tube in the case.

41. Secure the converter-to-flywheel attaching nuts and tighten them to 30 ft. lbs. (41 Nm).

42. Install the converter housing access cover and secure it with the attaching bolts.

43. Connect the driveshaft.

44. Adjust the shift linkage as required.

45. Lower the vehicle. Then install the 2 upper converter housing-to-engine bolts and tighten them.

46. Position the transmission fluid filler tube to the cylinder head and secure with the attaching bolts.

47. Make sure the drain pan is securely attached, and fill the transmission to the correct level with the Dexron®II fluid.

AOD Transmission

1. Raise the vehicle on hoist or stands.

2. Place the drain pan under the transmission fluid pan. Starting at the rear of the pan and working toward the front, loosen the attaching bolts and allow the fluid to drain. Finally remove all of the pan attaching bolts except 2 at the front, to allow the fluid to further drain. With fluid drained, install 2 bolts on the rear

side of the pan to temporarily hold it in place.

3. Remove the converter drain plug access cover from the lower end of the converter.

4. Remove the converter-to-flywheel attaching nuts. Place a wrench on the crankshaft pulley attaching bolt to turn the converter to gain access to the nuts.

5. Place a drain pan under the converter to catch the fluid. With the wrench on the crankshaft pulley attaching bolt, turn the converter to gain access to the converter drain plug and remove the plug. After the fluid has been drained, reinstall the plug.

6. On 2WD models, matchmark and disconnect the driveshaft from the rear axle and slide shaft rearward from the transmission. Install a seal installation tool in the extension housing to prevent fluid leakage.

7. Disconnect the cable from the terminal on the starter motor. Remove the 3 attaching bolts and remove the starter motor. Disconnect the neutral start switch wires at the plug connector.

8. Remove the rear mount-to-crossmember attaching bolts and the 2 crossmember-to-frame attaching bolts.

9. Remove the 2 engine rear support-to-extension housing attaching bolts.

10. Disconnect the TV linkage rod from the transmission TV lever. Disconnect the manual rod from the transmission manual lever at the transmission.

11. Remove the 2 bolts securing the bell crank bracket to the converter housing.

12. On 4WD models, remove the transfer case.

13. Raise the transmission with a transmission jack to provide clearance to remove the crossmember. Remove the rear mount from the crossmember and remove the crossmember from the side supports.

14. Lower the transmission to gain access to the oil cooler lines.

15. Disconnect each oil line from the fittings on the transmission.

16. Disconnect the speedometer cable from the extension housing.

17. Remove the bolt that secures the transmission fluid filler tube to the cylinder block. Lift the filler tube and the dipstick from the transmission.

18. Secure the transmission to the jack with the chain.

19. Remove the converter housing-to-cylinder block attaching bolts.

20. Carefully move the transmission and converter assembly away from the engine and, at the same time, lower the jack to clear the underside of the vehicle.

21. Remove the converter and mount the transmission in a holding fixture.

22. Tighten the converter drain plug.

To install:

23. Position the converter on the transmission, making sure the converter drive flats are fully engaged in the pump gear by rotating the converter.

24. With the converter properly installed, place the transmission on the jack. Secure the transmission to the jack with a chain.

25. Rotate the converter until the studs and drain plug are in alignment with the holes in the flywheel.

26. Move the converter and transmission assembly forward into position, using care not to damage the flywheel and the converter pilot. The converter must rest squarely against the flywheel. This indicates that the converter pilot is not binding in the engine crankshaft.

27. Install and tighten the converter housing-to-engine attaching bolts to 40-50 ft. lbs. (54-68 Nm).

28. Remove the safety chain from around the transmission.

29. Install a new O-ring on the lower end of the transmission filler tube. Insert the tube in the transmission case and secure the tube to the engine with the attaching bolt.

30. Connect the speedometer cable to the extension housing.

31. Connect the oil cooler lines to the right side of transmission case.

32. Position the crossmember on the side supports. Torque the bolts to 55 ft. lbs. (75 Nm). Position the rear mount on the crossmember and install the attaching nuts to 90 ft. lbs. (122 Nm).

33. On 4WD models, install the transfer case.

34. Secure the rear support to the extension housing and tighten the bolts to 80 ft. lbs. (109 Nm).

35. Lower the transmission and remove the jack.

E40D Transmission

1. Raise and support the vehicle safely.

2. Place the drain pan under the transmission fluid pan. Starting at the rear of the pan and working toward the front, loosen the attaching bolts and allow the fluid to drain. Fi-

nally remove all of the pan attaching bolts except 2 at the front, to allow the fluid to further drain. With fluid drained, install 2 bolts on the rear side of the pan to temporarily hold it in place.

3. Remove the dipstick from the transmission.

4. On 4WD models, matchmark and remove the front driveshaft.

5. Matchmark and remove the rear driveshaft. Install a seal installation tool in the extension housing to prevent fluid leakage.

6. Disconnect the linkage from the transmission.

7. On 4WD models, disconnect the transfer case linkage.

8. Remove the heat shield and remove the manual lever position sensor connector by squeezing the tabs and pulling on the connector; never attempt to pry the connector apart!

9. Remove the solenoid body heat shield.

10. Remove the solenoid body connector by pushing on the center tab and pulling on the wiring harness; never attempt to pry apart the connector!

11. On 4WD models, remove the 4x4 switch connector from the transfer case. Be careful not to over-extend the tabs.

12. Pry the harness connector from the extension housing wire bracket.

13. On 4WD models, remove the wiring harness locators from the left side of the connector.

14. Disconnect the speedometer cable.

15. On 4WD models, remove the transfer case.

16. Remove the converter cover bolts.

17. Remove the rear engine cover plate bolts.

18. Disconnect the cable from the terminal on the starter motor. Remove the 3 attaching bolts and remove the starter motor. Disconnect the neutral start switch wires at the plug connector.

19. Remove the converter-to-flywheel attaching nuts. Place a wrench on the crankshaft pulley attaching bolt to turn the converter to gain access to the nuts.

20. Secure the transmission to a transmission jack. Use a safety chain.

21. Remove the rear mount-to-crossmember attaching nuts and the 2 crossmember-to-frame attaching bolts.

22. Disconnect each oil line from the fittings on the transmission. ^{from Cap} the lines.

23. Remove the 6 converter housing-to-cylinder block attaching bolts.

24. Carefully move the transmission and converter assembly away from the engine and, at the same time, lower the jack to clear the underside of the vehicle.

25. Remove the transmission filler tube.

26. Install Torque Converter Handles T81P-7902-C, or equivalent, at the 12 o'clock and 6 o'clock positions.

To install:

27. Install the converter with the handles at the 12 o'clock and 6 o'clock positions. Push and rotate the converter until it bottoms out. Check the seating of the converter by placing a straightedge across the converter and bell housing. There must be a gap between the converter and straightedge. Remove the handles.

28. Install the transmission filler tube.

29. Rotate the converter to align the studs with the flywheel mounting holes.

30. Carefully raise the transmission into position at the engine. The converter must rest squarely against the flywheel.

31. Install the 6 converter housing-to-cylinder block attaching bolts. Snug them alternately and evenly,

then, tighten them alternately and evenly to 40-50 ft. lbs. (54-68 Nm).

32. Install the converter drain plug cover.

33. Connect each oil line at the fittings on the transmission.

34. Install the rear mount-to-crossmember attaching nuts and the 2 crossmember-to-frame attaching bolts. Torque the nuts and bolts to 50 ft. lbs. (68 Nm).

35. Remove the transmission jack.

36. Install the converter-to-flywheel attaching nuts. Place a wrench on the crankshaft pulley attaching bolt to turn the converter to gain access to the nuts. Torque the nuts to 20-30 ft. lbs. (27-41 Nm).

37. Install the starter motor. Connect the cable at the terminal on the starter motor. Connect the neutral start switch wires at the plug connector.

38. Install the rear engine cover plate bolts.

39. Install the converter cover bolts.

40. On 4WD models, install the transfer case.

41. Connect the speedometer cable.

42. On 4WD models, install the wiring harness locators at the left side of the connector.

43. Connect the harness connector at the extension housing wire bracket.

44. On 4WD models, install the 4x4 switch connector at the transfer case.

45. Install the solenoid body connector. An audible click indicates connection.

46. Install the solenoid body heat shield.

47. Install the manual lever position sensor connector and the heat shield.

48. On 4WD models, connect the transfer case linkage.

49. Connect the linkage at the transmission.

50. Install the rear driveshaft.

51. On 4WD models, install the front driveshaft.

52. Install the dipstick.

53. Install the drain pan using a new gasket and sealer.

54. Lower the vehicle.

55. Refill the transmission and check for leaks.

the retaining bolt and separating the two halves.

4. Raise and safely support the vehicle on jackstands.

5. Drain the transmission fluid.

6. Matchmark the rear driveshaft to the differential mounting flange and, on 4-wheel drive versions, to the transmission housing, then remove the 4 attaching bolts. Remove the driveshaft from the vehicle.

7. On 4-wheel drive models, remove the transfer case.

8. Remove the transmission inspection cover.

9. Remove the 4 torque converter nuts by rotating the crankshaft to gain access to all of the nuts.

10. Remove the starter motor.

11. Detach the transmission shift linkage.

12. Disconnect the transmission fluid cooler lines.

13. Detach the 2 heated oxygen sensor electrical connectors.

14. Position a transmission jack, or equivalent, under the transmission. Secure the transmission to the jack with a strap.

15. Remove the 2 transmission mount nuts.

16. Remove the 2 heat shield mounting bolts (one on each side).

17. Remove the 6 rear crossmember mounting bolts, then remove the crossmember from the vehicle.

18. Remove the rear transmission mount from the vehicle frame.

19. Remove the fluid fill tube.

20. Remove the exhaust pipe bracket.

21. Remove the fuel line bracket.

22. On 4.2L (VIN 2) engines, remove the 9 engine-to-transmission bolts.

23. Remove the 6 engine-to-transmission bolts on 4.6L engines.

24. Remove the 4 exhaust pipe-to-exhaust manifold nuts (two on each side) and position the exhaust pipe aside.

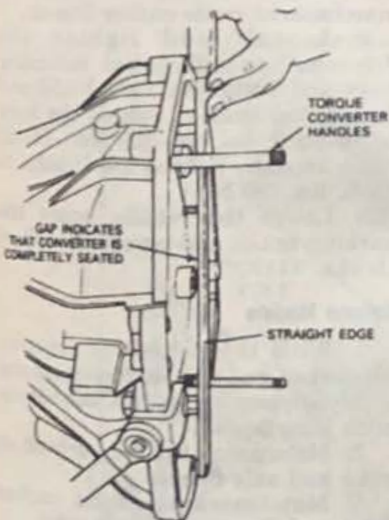
CAUTION

The torque converter is heavy and may result in injury if allowed to fall out of the transmission. Secure the torque converter in the transmission.

25. Slowly and carefully lower the transmission from the vehicle.

To install:

NOTE: Make sure that the torque converter is fully seated in the transmission before positioning the transmission to the engine.



70214-7

Torque converter installation — E400 automatic transmission — Bronco, F Series (Pick-Up) and E Series (Van)

4R70W Transmission

1. Disconnect the negative battery cable.

2. Place the transmission in Neutral.

3. Detach the transmission harness electrical connector by removing

26. Raise the transmission, with the torque converter installed, slowly and carefully up into the vehicle. When mating the transmission to the engine, align the orange balancing marks on the converter stud and fly-wheel bolt hole.

27. Position the exhaust pipe onto the exhaust manifold, then install the 4 mounting nuts to 25-34 ft. lbs. (34-46 Nm).

28. On 4.6L engines, install the 6 engine-to-transmission bolts and tighten to 30-41 ft. lbs. (40-55 Nm).

29. On 4.2L (VIN 2) engines, install the 9 engine-to-transmission bolts to 28-38 ft. lbs. (38-51 Nm).

30. Install the fuel line bracket and tighten the mounting nut to 13-17 ft. lbs. (17-23 Nm).

31. Install the exhaust bracket and tighten the 2 mounting nuts to 25-33 ft. lbs. (34-46 Nm).

32. Install the transmission mount and tighten the 2 mounting bolts to 64-81 ft. lbs. (87-110 Nm).

33. Install the rear crossmember into the vehicle. Tighten the 6 cross-member mounting bolts to 39-53 ft. lbs. (53-72 Nm).

34. Install the 2 heat shield bolts, then install the 2 transmission-to-transmission mount nuts to 64-81 ft. lbs. (87-110 Nm).

35. Lower the transmission jack slowly.

36. Attach the 2 heated oxygen sensor electrical connectors, then install the starter motor.

37. Connect the transmission fluid cooler lines.

38. Slide the transmission shift linkage into the cable bracket until the tabs are fully seated, then connect the shift cable to the transmission selector lever.

39. Install the starter motor.

40. Rotate the crankshaft to gain access to the torque converter-to-fly-wheel studs and install the mounting nuts finger-tight. Install all of the nuts in this manner, then rotate the crankshaft a second time and tighten the mounting nuts to 10 ft. lbs. (14 Nm). Rotate the crankshaft a third time and finally tighten the nuts to 20-34 ft. lbs. (27-46 Nm).

41. Install the transmission inspection cover. Tighten the mounting bolts to 22-30 ft. lbs. (30-40 Nm).

42. Install the fluid fill tube.

43. For vehicles equipped with 4-wheel drive, install the transfer case.

44. Install the rear driveshaft. Mount the driveshaft to the differential flange so that the matchmarks

align, then tighten the 4 mounting bolts to 65-87 ft. lbs. (88-119 Nm).

45. Lower the vehicle.

46. Attach the transmission electrical wiring harness connector.

47. Connect the negative battery cable.

48. Fill the transmission with transmission fluid. Make sure to use MERCON Multi-Purpose Automatic Transmission Fluid XT-2-QDX or DDX, or equivalent.

Throttle Valve Cable

ADJUSTMENT

AOD Transmission with EFI Fuel System

Adjustment with Engine OFF

1. Set the parking brake and put the selector lever in N.

2. Remove the protective cover from the cable.

3. Make sure the throttle lever is at the idle stop. If it isn't, check for binding or interference. Never attempt to adjust the idle stop!

4. Make sure the cable is free of sharp bends or is not rubbing on anything throughout its entire length.

5. Lubricate the TV lever ball stud with chassis grease.

6. Unlock the locking tab at the throttle body by prying with a small prybar.

7. Install a spring on the TV control lever, to hold it in the rear-most travel position. The spring must exert at least 10 lbs. (14 Nm) of force on the lever.

8. Rotate the transmission outer TV lever 10-30 degrees and slowly allow it to return.

9. Push down on the locking tab until flush.

10. Remove the retaining spring from the lever.



Unlocking TV cable locking tab — 5.0L (VIN N) engine

DRIVE LINE

Driveshaft

REMOVAL AND INSTALLATION

One Piece Rear Driveshaft

Except Bronco Models

1. With the vehicle in Neutral, block the front wheels, then raise and safely support the rear of the vehicle with jackstands.

2. Matchmark the driveshaft yoke and axle pinion flange.

3. Remove the driveshaft flange or Universal joint-to-differential flange nuts and bolts.

4. Separate the yoke from the differential flange. It may be necessary to pry it free with a small prybar. Immediately after separation, wrap tape around the U-joint caps to keep them from falling off.

5. Slip the driveshaft off the transmission splines.

To install:

6. Slide the front driveshaft yoke into the rear transmission extension housing so that the splines are aligned.

7. Situate the rear end of the driveshaft in position on the differential flange, making sure that the matchmarks made earlier line up.

8. Install and tighten the driveshaft-to-differential mounting nuts and bolts. On 1997 F-150 and Expedition models, tighten the bolts to 70-95 ft. lbs. (95-129 Nm). On all other models, tighten the U-bolts to 15 ft. lbs. (20 Nm).

9. Lower the vehicle, apply the parking brake and remove the wheel chocks.

Bronco Models

1. With the vehicle in Neutral, block the front wheels, then raise and safely support the rear of the vehicle with jackstands.

2. Matchmark the rear driveshaft yoke and axle flange.

3. Matchmark the front cardan joint and the transfer case yoke.

4. Remove the U-bolt nuts and U-bolts attaching the yoke to the axle flange.

5. Separate the yoke from the flange. It may be necessary to pry it free with a small prybar. Immediately after separation, wrap tape around the U-joint caps to keep them from falling off.

6. Remove the cardan joint-to-transfer case yoke bolts and separate the cardan joint from the yoke.

To install:

7. Position the front driveshaft flange against the transfer case or transmission flange. Make sure that the matchmarks align, then install the mounting bolts to 25 ft. lbs. (34 Nm).

8. Situate the rear end of the driveshaft in position on the differential flange, making sure that the matchmarks made earlier line up.

9. Install and tighten the driveshaft-to-differential mounting nuts and bolts. Tighten the U-bolts to 15 ft. lbs. (20 Nm).

10. Lower the vehicle, apply the parking brake and remove the wheel chocks.

Two Piece Rear Driveshaft

1. With the vehicle in Neutral, block the front wheels, then raise and safely support the rear of the vehicle with jackstands.

2. Matchmark the driveshaft yoke and axle pinion flange.

3. Remove the nuts and U-bolts, if applicable, attaching the yoke to the axle flange.

4. Separate the yoke from the flange. It may be necessary to pry it free with a small prybar. Immediately after separation, wrap tape around the U-joint caps to keep them from falling off.

5. Slip the driveshaft off the coupling shaft splines.

6. Remove the center bearing.

7. Slide the coupling shaft from the transmission shaft splines.

To install:

8. Clean all parts and check for damage. Do not remove the blue plastic coating from the male splines.

9. Slide the coupling driveshaft into the transmission output shaft, then position it and the center bearing support onto the vehicle. Tighten the center bearing support mounting bolts to 39-53 ft. lbs. (53-72 Nm).

10. Slide the rear driveshaft into the mating splines of the coupling shaft, then situate the rear driveshaft onto the rear differential input flange making sure to align the matchmarks made earlier. Tighten the attaching bolts to 70-95 ft. lbs. (95-129 Nm) for 1997 F-150 and Expedition models. For vehicles with conventional U-bolts and nuts,

tighten them to the following specifications dependant on size:

- $\frac{3}{16}$ in.-18: 15 ft. lbs. (20 Nm)
- $\frac{1}{2}$ in.-18: 17-26 ft. lbs. (23-35 Nm)
- $\frac{7}{16}$ in.-20: 30-40 ft. lbs. (41-54 Nm)

11. Lower the vehicle to the ground and remove the wheel chocks.

Front Driveshaft

1. Matchmark the driveshaft yoke and axle pinion flange.

2. Matchmark the driveshaft yoke and transfer case flange.

3. Remove the U-bolt nuts and U-bolts attaching the yoke to the axle flange.

4. Separate the yoke from the flange. It may be necessary to pry it free with a small prybar. Immediately after separation, wrap tape around the U-joint caps to keep them from falling off.

5. Remove the U-bolts and nuts (bolts for the F-350, 1997 F-150 and Expedition) and disconnect the driveshaft from the transfer case. It may be necessary to pry it free with a small prybar. Immediately after separation, wrap tape around the U-joint caps to keep them from falling off.

NOTE: Avoid separating the driveshaft parts at the slip joint. If the driveshaft should become separated, follow the procedure, below.

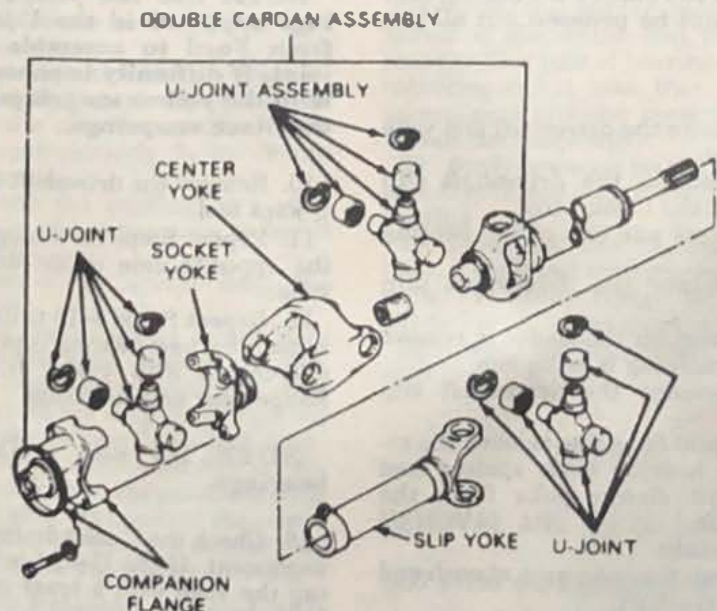
To install:

6. Situate the rear end of the driveshaft in position on the differential flange, making sure that the matchmarks made earlier line up.

7. Install and tighten the driveshaft-to-differential mounting nuts and bolts. Tighten the U-bolts (except F-350 and 1997 F-150 and Expedition models) to 15 ft. lbs. (20 Nm). Tighten the F-350 bolts to 20-28 ft. lbs. (27-38 Nm). Tighten the 1997 F-150 and Expedition driveshaft-to-front differential bolts to 65-88 ft. lbs. (88-119 Nm).

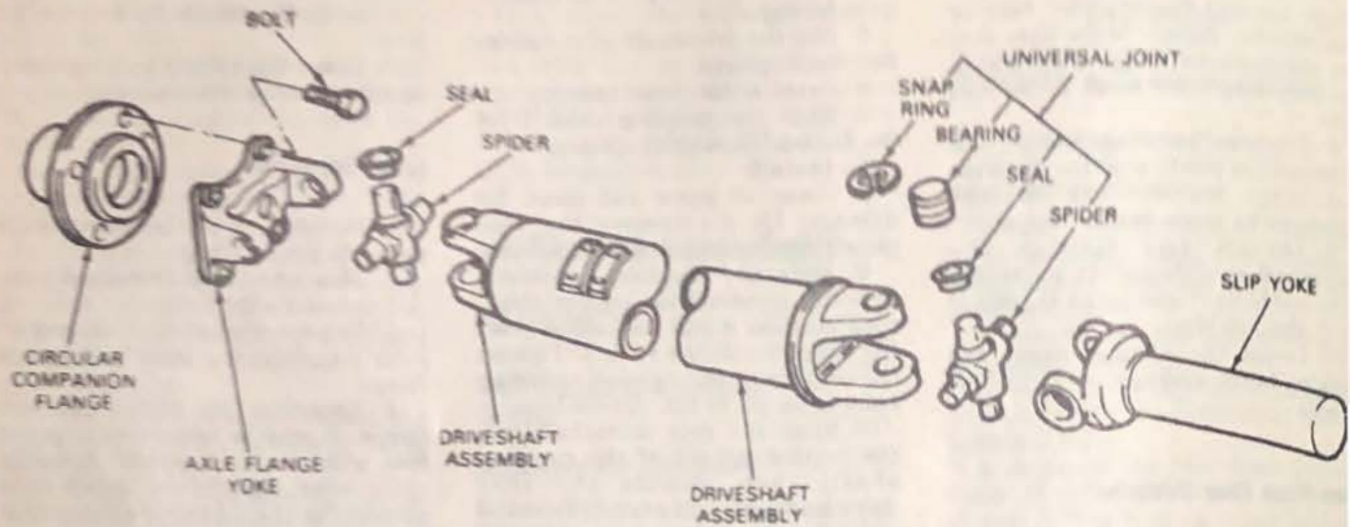
8. Position the front driveshaft flange against the transfer case or transmission flange. Make sure that the matchmarks align, then install the mounting bolts to 20-28 ft. lbs. (27-38 Nm) for F-350, to 65-88 ft. lbs. (88-119 Nm) for 1997 F-150 and Expedition models, and to 15 ft. lbs. (20 Nm) for all others.

9. Lower the vehicle, apply the parking brake and remove the wheel chocks.



Double Cardan U-joint assembly — F-350 and Bronco

79215gb0



One-piece driveshaft — Bronco, F Series (Pick-Up) and E Series (Van)

U-Joints

REMOVAL AND INSTALLATION

Single Cardan-Type U-Joint

NOTE: To correctly disassemble and reassemble the Universal joints (U-joints), Ford Tool T74P-4635-C, or its equivalent, is necessary.

1. Remove the driveshaft, from which the U-joint is to be removed, from the vehicle.

WARNING

Do not clamp the driveshaft in the jaws of a vise or similar holding fixture.

2. Place the driveshaft on a suitable work table, being careful not to damage the driveshaft tube.

NOTE: Make sure to mark all components, otherwise the driveshaft assembly may be assembled so that it is out of balance.

3. Matchmark the positions of the driveshaft components.

4. Clamp U-joint Tool T74P-4635-C in a vise.

5. Remove the snaprings from the U-joint ends.

NOTE: If necessary, use a pair of pliers to remove a bearing cup if it cannot be pressed out all the way.

6. Remove the driveshaft slip yoke as follows:

a. Position the driveshaft slip yoke in the U-joint tool.

b. Press out one of the bearing cups.

c. Rotate the driveshaft slip yoke.

d. Press on the spider to remove the remaining bearing cup.

e. Remove the driveshaft slip yoke.

7. Repeat Step 6 to remove the remaining bearing cups, spiders and driveshaft flange yoke from the driveshaft.

To install:

8. Clean the yoke area at each end of the driveshaft.

9. Install the bearing cup as follows:

a. Start a new bearing cup into the driveshaft yoke.

b. Position the new spider in the driveshaft yoke.

c. Position the driveshaft in the U-joint tool.

d. Press the bearing cup $\frac{1}{4}$ in (6.3mm) below the yoke surface.

NOTE: Use the yellow snaprings supplied in the U-joint kit from Ford to assemble the U-joint. If difficulty is encountered with the yellow snaprings, install the black snaprings.

10. Remove the driveshaft from the U-joint tool.

11. Repeat Steps 9a through 9d for the opposite side of the driveshaft yoke.

12. Repeat Steps 8-10 to install the remaining new bearing cups, spiders, driveshaft slip yoke, driveshaft flange yoke and snaprings.

NOTE: Do not strike the bearings.

13. Check the U-joint for freedom of movement. If the U-joint is binding, tap the yoke with a brass or plastic hammer.

14. If necessary, use Premium Long-Life Grease XG-1-C or -K, or equivalent, to lubricate the U-joints.

15. Install the driveshaft in the vehicle.

Double Cardan-Type U-Joints

NOTE: To correctly disassemble and reassemble the Universal joints (U-joints), Ford Tool T74P-4635-C, or its equivalent, is necessary.

1. Remove the driveshaft, from which the U-joint is to be removed, from the vehicle.

WARNING

Do not clamp the driveshaft in the jaws of a vise or similar holding fixture.

2. Place the driveshaft on a suitable work table, being careful not to damage the driveshaft tube.

NOTE: Make sure to mark all components, otherwise the driveshaft assembly may be assembled so that it is out of balance.

3. Matchmark the positions of the spiders, the center yoke, and the centering socket yoke as related to the stud yoke, which is welded to the front of the driveshaft tube.

4. Remove the snaprings that secure the bearings in the front of the center yoke.

5. Using the U-joint tool, press out one of the bearings until it protrudes approximately $\frac{3}{8}$ in. (9mm) out of the yoke.

6. Clamp the bearing in a vise and tap on the center yoke to free it from the bearing.

7. Lift the two bearing cups from the spider.

8. Reposition the tool on the yoke and move the remaining bearing in the opposite direction so that it protrudes approximately $\frac{3}{8}$ in. (9mm) out of the yoke.

9. Clamp the bearing in a vise, then tap on the center yoke to free it from the bearing.

10. Remove the spider from the center yoke.

11. Pull the centering socket yoke off the center stud. Remove the rubber seal from the centering ball stud.

12. Remove the snap rings from the center yoke and the driveshaft yoke.

13. Position the U-joint tool on the driveshaft yoke and press the bearing outward until the inside of the center yoke almost contacts the slinger ring at the front of the driveshaft yoke.

NOTE: Pressing beyond this point can distort the slinger ring.

14. Clamp the exposed end of the bearing in a vise and drive on the center yoke with a soft-faced hammer to free it from the bearing.

15. Reposition the tool and press on the spider to remove the opposite bearing.

16. Remove the center yoke from the spider.

17. Remove the spider from the driveshaft yoke in the same manner.

18. Clean all serviceable parts in cleaning solvent. If using a repair kit, install all of the parts supplied in the kit. If the driveshaft is damaged, replace the complete shaft to be assured of a balanced assembly.

To install:

NOTE: Universal joints are to be installed as complete units only. Do not mix any components from other universal joints.

19. To assemble the double Cardan joints, position the spider in the driveshaft yoke. Make sure the spider bosses (or lubrication plugs on kits) will be in the same position as originally installed. Press in the bearing using the U-joint tool. Install the snaprings.

20. Pack the socket relief and the ball with Premium Long-Life Grease XG-1-C or -K or equivalent, then position the center yoke over the spider ends and press in the bearing. In the snaprings.

21. Install a new seal on the centering ball stud. Position the centering socket yoke on the stud.

22. Place the front spider in the center yoke. Make sure the spider bosses are properly positioned.

23. With the spider loosely positioned on the center stop, proceed to seat the first pair of bearings into the centering socket yoke, then press the second pair into the centering yoke. Install the snaprings.

24. Apply pressure on the centering socket yoke and install the remaining bearing cup.

25. Lubricate the U-joint assemblies, if equipped with grease fittings, with Premium Long-Life Grease XG-1-C or -K, or equivalent grease.

26. Install the driveshaft into the vehicle.

Halfshaft

REMOVAL AND INSTALLATION

1997 F-150 and Expedition Models

1. Break the front wheel lug nuts loose while the weight of the vehicle is resting on the front wheels.

2. Raise and safely support the front of the vehicle on jackstands.

3. Remove the front wheels.

4. Remove the front hub cotter pin, retainer and nut.

5. Using a floor hydraulic jack, support the lower suspension arm.

6. Remove the upper ball joint cotter pin and castle nut.

7. Use a Pitman arm puller, such as Ford Tool T64P-3590-F, to separate the front wheel knuckle from the front suspension upper arm.

8. Lower the lower suspension arm and steering knuckle slightly to facilitate easier halfshaft removal.

9. Remove the 2 disc caliper mounting bolts, then lift the front disc caliper off of the front disc brake caliper anchor plate and position aside. Do not allow the caliper to hang by the brake hose; suspend it from the vehicle's frame with strong cord or wire.

10. Remove the 6 front halfshaft-to-differential bolts.

WARNING

Use care to avoid damaging the hub seal when removing the front halfshaft.

11. Remove the inboard end of the halfshaft from the differential case or extension axle case. Separate the front halfshaft and joints from the hub, then remove the halfshaft and joints from the vehicle.

To install:

12. Slide the halfshaft outboard end into the hub, making sure that the splines engage.

13. Situate the inboard end of the halfshaft against the front differential flange and install the 6 halfshaft-to-differential bolts. Tighten the halfshaft bolts to 51-67 ft. lbs. (68-92 Nm).

14. Install the front disc brake caliper onto the rotor and anchor plate, then install and tighten the 2 caliper mounting bolts to 21-26 ft. lbs. (28-36 Nm).

15. Lift the lower suspension arm and steering knuckle up until the upper ball joint stud is inserted into the steering knuckle. Install the upper ball joint castle nut and tighten to 57-76 ft. lbs. (77-104 Nm). Install a new cotter pin.

16. Install the hub nut onto the halfshaft and tighten the hub nut to 188-254 ft. lbs. (255-345 Nm).

17. Install the hub nut retainer and a new cotter pin.

18. Install the front wheels and tighten the lug nuts in a star-shaped sequence to 83-112 ft. lbs. (113-153 Nm).

19. Lower the vehicle to the ground.

CV-Joint Boot

REMOVAL AND INSTALLATION

1997 F-150 and Expedition Models

NOTE: To adequately perform this procedure CV Boot Clamp Installer T95P-3514-A, or its equivalent, is necessary.

1. Remove the front halfshaft from the vehicle.
2. Slide the 2 inboard clamp protectors off of the boot clamps.

WARNING

Be careful not to damage the halfshaft boot.

3. Remove the 2 inboard boot clamps.
4. Slide the inboard boot off of the inboard CV-joint housing.
5. Remove the inboard CV-joint retaining ring.
6. Remove the inboard CV-joint housing from the front differential housing.
7. Matchmark the inner race and the ball cage for reassembly.
8. Remove the 6 balls from the ball cage.
9. Remove the snapping retaining the inner race onto the halfshaft.
10. Slide the inner race and ball cage off of the halfshaft.
11. Slide the inboard CV-joint boot off of the halfshaft.
12. Remove the 2 outboard clamp protectors, then grab the boot clamps and peel them away from the halfshaft boot.
13. Remove the outboard CV-joint boot from the halfshaft.
14. Clean and inspect the joint for wear. Replace the joint if worn or damaged.

To install:

15. Pack the outboard CV-joint with Ford High Temp Constant Velocity Joint Grease, or equivalent. Spread any remaining grease from the service kit evenly inside of the outboard halfshaft boot.
16. Clean the CV-joint boot mounting surface, then position the outboard CV-joint boot on the shaft and in the CV-joint grooves. Position the boot clamps in place.

NOTE: Tighten the through-bolt until the installer is in the closed position.

17. Using CV Boot Clamp Installer T95P-3514-A, tighten the boot clamps.
18. Install the 2 outboard clamp protectors.

19. Position the inboard clamp protector and the boot clamp on the halfshaft and CV-joint.

20. Position the inboard boot on the halfshaft.

21. Position the ball cage on the CV-joint section of the halfshaft with the tapered end installed first.

NOTE: Line up the marks made during disassembly.

22. Position the inner race on the halfshaft with the counterbored end installed on the shaft first.

23. Install a new snapping in the groove at the inner end of the halfshaft.

24. Lubricate the 6 balls with Ford High Temp Constant Velocity Joint Grease, or equivalent, then position them in the ball cage.

25. Position the clamp protector and the inboard boot clamp on the inboard CV-joint housing (front differential).

26. Fill the inboard CV-joint housing with 8.29 oz. (235 g) of CV-joint high temp grease.

27. Position the inboard CV-joint housing into the differential housing flange, then install the retaining ring to secure in place.

28. Remove any excess grease from the mating surface, then position the inboard CV-joint boot over the CV-joint and differential housing flange.

29. Adjust the CV-joint-to-boot spacing and overall halfshaft assembled length. The assembled length should be 16.43 in. (417.25mm).

NOTE: The air should be released only after adjusting the CV-joint-to-boot spacing.

30. Insert a flat pry tool under the edge of the CV-joint boot to release built up air pressure in the boot.

31. Use the CV-joint boot installer tool, then tighten the 2 inboard boot clamps.

32. Position the clamp protectors over the inboard boot clamps.

33. Install the front halfshaft into the vehicle.

Transfer Case Assembly

REMOVAL AND INSTALLATION

CAUTION

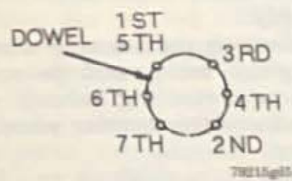
The catalytic converter is located beside the transfer case. Due to the extreme high temperatures generated by the converter, be careful when removing the transfer case or personal injury may result.

Borg-Warner Model 13-45

1. Raise and support the vehicle safely.
2. Drain the fluid from the transfer case.
3. Disconnect the 4WD indicator switch wire connector at the transfer case.
4. Remove the skid plate from the frame, if equipped.
5. Matchmark and disconnect the front driveshaft from the front output yoke.
6. Matchmark and disconnect the rear driv shaft from the rear output shaft yoke.
7. Disconnect the speedometer driven gear from the transfer case rear bearing retainer.
8. Remove the retaining rings and shift rod from the transfer case shift lever.
9. Disconnect the vent hose from the transfer case.
10. Remove the heat shield from the frame.
11. Support the transfer case with a transmission jack.
12. Remove the bolts retaining the transfer case to the transmission adapter.
13. Lower the transfer case from the vehicle.

To install:

14. When installing place a new gasket between the transfer case and the adapter.
15. Raise the transfer case with the transmission jack so the transmission output shaft aligns with the splined transfer case input shaft. Install the bolts retaining the transfer case to the adapter.
16. Remove the transmission jack from the transfer case.
17. Connect the rear driveshaft to the rear output shaft yoke. Torque the bolts to 15 ft. lbs. (20 Nm).
18. Install the shift lever to the transfer case and install the retaining nut.
19. Connect the speedometer driven gear to the transfer case.
20. Connect the 4WD indicator switch wire connector at the transfer case.
21. Connect the front driveshaft to the front output yoke. Torque the bolts to 15 ft. lbs. (20 Nm).
22. Position the heat shield to the frame crossmember and the mounting lug on the transfer case. Install and tighten the retaining bolts.
23. Install the skid plate to the frame.
24. Install the drain plug. Remove the filler plug and install 6 pints of



Transfer case-to-adaptor bolt torque sequence — Borg-Warner 13-45

Dexron®II type transmission fluid or equivalent.

25. Lower the vehicle.

Borg-Warner Model 13-56

Manual Shift Version

1. Raise and support the vehicle safely.
2. Drain the fluid from the transfer case.
3. Disconnect the 4WD indicator switch wire connector at the transfer case.
4. Remove the skid plate from the frame, if equipped.
5. Matchmark and disconnect the front driveshaft from the front output yoke.
6. Matchmark and disconnect the rear driveshaft from the rear output shaft yoke.
7. Disconnect the speedometer driven gear from the transfer case rear bearing retainer.
8. Remove the retaining rings and shift rod from the transfer case shift lever.
9. Disconnect the vent hose from the transfer case.
10. Remove the heat shield from the frame.
11. Support the transfer case with a transmission jack.
12. Remove the bolts retaining the transfer case to the transmission adapter.
13. Lower the transfer case from the vehicle.

To install:

14. When installing place a new gasket between the transfer case and the adapter.
15. Raise the transfer case with the transmission jack so the transmission output shaft aligns with the splined transfer case input shaft. Install the bolts retaining the transfer case to the adapter. Torque the bolts to 40 ft. lbs. (54 Nm).
16. Remove the transmission jack from the transfer case.

17. Connect the rear driveshaft to the rear output shaft yoke. Torque the bolts to 15 ft. lbs. (20 Nm).

18. Install the shift lever to the transfer case and install the retaining nut.

19. Connect the speedometer driven gear to the transfer case.

20. Connect the 4WD indicator switch wire connector at the transfer case.

21. Connect the front driveshaft to the front output yoke. Torque the bolts to 15 ft. lbs. (20 Nm).

22. Position the heat shield to the frame crossmember and the mounting lug on the transfer case. Install and tighten the retaining bolts.

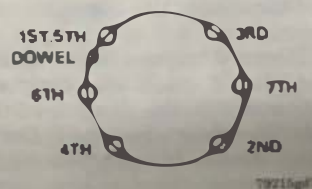
23. Install the skid plate to the frame.

24. Install the drain plug. Remove the filler plug and install 6 pints of Dexron®II type transmission fluid or equivalent.

25. Lower the vehicle.

Electronic Shift Version

1. Raise and support the vehicle safely.
2. Drain the fluid from the transfer case.
3. Disconnect the wire connector at the transfer case.
4. Remove the skid plate from the frame, if equipped.
5. Matchmark and disconnect the front driveshaft from the front output yoke.
6. Matchmark and disconnect the rear driveshaft from the rear output shaft yoke.
7. Disconnect the speedometer driven gear from the transfer case rear bearing retainer.
8. Disconnect the vent hose from the transfer case.
9. Remove the heat shield from the frame.
10. Support the transfer case with a transmission jack.



Transfer case-to-adaptor bolt torque sequence — Borg-Warner 13-56 electronic and manual shift transfer case — Bronco, F Series (Pick-Up) and E Series (Van)

11. Remove the bolts retaining the transfer case to the transmission adapter.

12. Lower the transfer case from the vehicle.

13. When installing place a new gasket between the transfer case and the adapter.

To install:

14. Raise the transfer case with the transmission jack so the transmission output shaft aligns with the splined transfer case input shaft. Install the bolts retaining the transfer case to the adapter. Torque the bolts to 40 ft. lbs. (54 Nm).

15. Remove the transmission jack from the transfer case.

16. Connect the rear driveshaft to the rear output shaft yoke. Torque the bolts to 28 ft. lbs. (38 Nm).

17. Install the shift lever to the transfer case and install the retaining nut.

18. Connect the speedometer driven gear to the transfer case. Tighten the bolt to 25 inch lbs. (2 Nm).

19. Connect the wire connector at the transfer case.

20. Connect the front driveshaft to the front output yoke. Torque the bolts to 15 ft. lbs. (20 Nm).

21. Position the heat shield to the frame crossmember and the mounting lug on the transfer case. Install and tighten the retaining bolts.

22. Install the skid plate to the frame.

23. Install the drain plug. Remove the filler plug and install 6 pints of Dexron®II type transmission fluid or equivalent.

24. Lower the vehicle.

Borg-Warner 44-06

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle on jackstands.
3. Drain the transfer case fluid into a large pan or container; dispose of the used fluid.
4. Remove the front and rear driveshafts from the transfer case.
5. Remove the torsion bars from the torsion bar rear support.
6. Remove the transfer case skid plate by removing the 4 mounting bolts, then lowering the skid plate from the vehicle.
7. On manual shift vehicles, Shift Linkage Insulator, T67P-7341-A, or equivalent, to connect the shift rod.
8. Detach the Vehicle Speed Sensor (VSS) electrical connector.

9. On manual shift vehicles, detach the 4WD indicator switch and the transfer case coil electrical connectors.

10. On electrical shift vehicles, detach the electric shift motor wiring harness connector.

11. Support the transfer case with an hydraulic floor transmission jack, or equivalent. Secure the transfer case to the jack with a safety strap.

12. Remove the 6 transfer case-to-transmission bolts (3 on each side).

13. Lower the transfer case out of the vehicle.

To install:

14. Raise the transfer case into position with the transmission jack.

15. Install the 6 transfer case-to-transmission bolts to 30-40 ft. lbs. (40-54 Nm). remove the transfer case-to-transmission jack securing strap.

16. On manual shift vehicles, attach the transfer case coil wiring harness connector. Also attach the 4WD indicator switch electrical connector.

17. Attach the VSS wiring harness connector.

18. On manual shift transfer cases, use the shift linkage tool to connect the shift rod.

19. On electrical shift models, attach the electric shift motor wiring harness connector.

20. Situate the transfer case skid plate into position, then install the 4 mounting bolts to 115-150 inch lbs. (13-17 Nm).

21. Install the torsion bars and the torsion bar rear support.

22. Install the driveshafts.

23. Fill the transfer case using Motorcraft MERCON Multi-Purpose Automatic Transmission Fluid XT-2-QDX or DDX, or equivalent fluid.

24. Lower the vehicle.

25. Connect the negative battery cable.

STEERING

Air Bag

CAUTION

Some vehicles are equipped with an air bag system, also known as the Supplemental Inflatable Restraint (SIR) or Supplemental Restraint System (SRS). The system must be disabled before performing service on or around system

components, steering column, instrument panel components, wiring and sensors. Failure to follow safety and disabling procedures could result in accidental air bag deployment, possible personal injury and unnecessary system repairs.

PRECAUTIONS

Several precautions must be observed when handling the inflator module to avoid accidental deployment and possible personal injury.

- Never carry the inflator module by the wires or connector on the underside of the module.

- When carrying a live inflator module, hold securely with both hands, and ensure that the bag and trim cover are pointed away.

- Place the inflator module on a bench or other surface with the bag and trim cover facing up.

- With the inflator module on the bench, never place anything on or close to the module which may be thrown in the event of an accidental deployment.

DISARMING

For the Air Bag system on the Ford full-sized trucks, the positive battery cable must be disconnected for a minimum of one minute before beginning any air bag work to de-energize the backup power supply. It is a good idea to disconnect both the positive and negative battery cables to ensure that the Air Bag system is definitely discharged.

Steering Wheel

REMOVAL AND INSTALLATION

Without Air Bag

1. Set the front wheel in the straight ahead position.

2. Disconnect the negative battery cable.

3. Remove the one screw from the underside of each steering wheel spoke, and lift the horn switch assembly (steering wheel pad) from the steering wheel. If equipped with the sport steering wheel option, pry the button cover off with a prybar.

4. Disconnect the horn switch wires at the connector and remove the switch assembly. If equipped with speed control, squeeze the J-clip ground wire terminal firmly and pull it out of the hole in the steering

wheel. Don't pull the wire out without squeezing the clip.

5. Remove the horn switch assembly.

6. Remove the steering wheel retaining nut, matchmark the steering wheel and steering column shaft, then remove the steering wheel with a puller.

WARNING

Never hammer on the wheel or shaft to remove it! Never use a knock-off type puller.

To install:

7. Slide the steering wheel onto the steering column shaft so that the matchmarks align, then draw the steering wheel onto the column fully by tighten the steering wheel retaining nut to 40 ft. lbs. (54 Nm).

8. Install the horn switch assembly to the steering wheel, then attach the speed control wiring harness connector, if applicable, and the horn switch connector.

9. Position the horn pad onto the steering wheel, then install the retaining screws until snug.

10. Connect the negative battery cable.

With Air Bag

1. Set the front wheel in the straight ahead position.

CAUTION

The residual power supply must be discharged before any air bag component is serviced.

2. Disconnect the battery-to-starter relay cable for at least one minute to allow the Air Bag system backup power supply to discharge.

3. Remove the 4 air bag module retaining nuts (2 screws for 1997 F-150 and Expedition models) from the air bag module on the back side of the steering wheel, then lift the module away from the steering wheel.

4. Detach the air bag wiring harness connector, and remove the module from the steering wheel.

5. Detach the horn/speed control wiring harness connector.

6. Remove the steering wheel retaining bolt.

7. Using a 2-jawed puller, such as Steering Wheel Puller T77L-4220-B1, remove the steering wheel from the steering column shaft.

WARNING

Never hammer on the wheel or shaft to remove it! Never use a knock-off type puller.

9. On manual shift vehicles, detach the 4WD indicator switch and the transfer case coil electrical connectors.

10. On electrical shift vehicles, detach the electric shift motor wiring harness connector.

11. Support the transfer case with an hydraulic floor transmission jack or equivalent. Secure the transfer case to the jack with a safety strap.

12. Remove the 6 transfer case-to-transmission bolts (3 on each side).

13. Lower the transfer case out of the vehicle.

To install:

14. Raise the transfer case into position with the transmission jack.

15. Install the 6 transfer case-to-transmission bolts to 30-40 ft. lbs. (40-54 Nm). remove the transfer case-to-transmission jack securing strap.

16. On manual shift vehicles, attach the transfer case coil wiring harness connector. Also attach the 4WD indicator switch electrical connector.

17. Attach the VSS wiring harness connector.

18. On manual shift transfer cases, use the shift linkage tool to connect the shift rod.

19. On electrical shift models, attach the electric shift motor wiring harness connector.

20. Situate the transfer case skid plate into position, then install the 4 mounting bolts to 115-150 inch lbs. (13-17 Nm).

21. Install the torsion bars and the torsion bar rear support.

22. Install the driveshafts.

23. Fill the transfer case using Motorcraft MERCON Multi-Purpose Automatic Transmission Fluid XT-2-QDX or DDx, or equivalent fluid.

24. Lower the vehicle.

25. Connect the negative battery cable.

STEERING

Air Bag

CAUTION

Some vehicles are equipped with an air bag system, also known as the Supplemental Inflatable Restraint (SIR) or Supplemental Restraint System (SRS). The system must be disabled before performing service on or around system

components, steering column, instrument panel components, wiring and sensors. Failure to follow safety and disabling procedures could result in accidental air bag deployment, possible personal injury and unnecessary system repairs.

PRECAUTIONS

Several precautions must be observed when handling the inflator module to avoid accidental deployment and possible personal injury.

- Never carry the inflator module by the wires or connector on the underside of the module.

- When carrying a live inflator module, hold securely with both hands, and ensure that the bag and trim cover are pointed away.

- Place the inflator module on a bench or other surface with the bag and trim cover facing up.

- With the inflator module on the bench, never place anything on or close to the module which may be thrown in the event of an accidental deployment.

DISARMING

For the Air Bag system on the Ford full-sized trucks, the positive battery cable must be disconnected for a minimum of one minute before beginning any air bag work to de-energize the backup power supply. It is a good idea to disconnect both the positive and negative battery cables to ensure that the Air Bag system is definitely discharged.

Steering Wheel

REMOVAL AND INSTALLATION

Without Air Bag

1. Set the front wheel in the straight ahead position.

2. Disconnect the negative battery cable.

3. Remove the one screw from the underside of each steering wheel spoke, and lift the horn switch assembly (steering wheel pad) from the steering wheel. If equipped with the sport steering wheel option, pry the button cover off with a prybar.

4. Disconnect the horn switch wires at the connector and remove the switch assembly. If equipped with speed control, squeeze the J-clip ground wire terminal firmly and pull it out of the hole in the steering

wheel. Don't pull the wire out without squeezing the clip.

5. Remove the horn switch assembly.

6. Remove the steering wheel retaining nut, matchmark the steering wheel and steering column shaft, then remove the steering wheel with a puller.

WARNING

Never hammer on the wheel or shaft to remove it! Never use a knock-off type puller.

To install:

7. Slide the steering wheel onto the steering column shaft so that the matchmarks align, then draw the steering wheel onto the column fully by tightening the steering wheel retaining nut to 40 ft. lbs. (54 Nm).

8. Install the horn switch assembly to the steering wheel, then attach the speed control wiring harness connector, if applicable, and the horn switch connector.

9. Position the horn pad onto the steering wheel, then install the retaining screws until snug.

10. Connect the negative battery cable.

With Air Bag

1. Set the front wheel in the straight ahead position.

CAUTION

The residual power supply must be discharged before any air bag component is serviced.

2. Disconnect the battery-to-starter relay cable for at least one minute to allow the Air Bag system backup power supply to discharge.

3. Remove the 4 air bag module retaining nuts (2 screws for 1997 F-150 and Expedition models) from the air bag module on the back side of the steering wheel, then lift the module away from the steering wheel.

4. Detach the air bag wiring harness connector, and remove the module from the steering wheel.

5. Detach the horn/speed control wiring harness connector.

6. Remove the steering wheel retaining bolt.

7. Using a 2-jawed puller, such as Steering Wheel Puller T77L-4220-B1, remove the steering wheel from the steering column shaft.

WARNING

Never hammer on the wheel or shaft to remove it! Never use a knock-off type puller.

To install:

8. Make sure that the vehicle's wheels are pointing straight ahead.

9. Route the air bag sliding contact wire harness through the steering wheel opening at the 3 o'clock position. Situate the steering wheel on the steering column shaft so that the matchmarks are aligned. Be sure that the air bag wire is not pinched.

WARNING

Be sure that the wiring does not get trapped between the steering wheel and the air bag sliding contact.

10. Install a new steering wheel retaining bolt and tighten it to 23–32 ft. lbs. (31–44 Nm).

11. Attach the horn/speed control wiring harness to the contact harness, and snap the connector onto the steering wheel clip.

12. Attach the air bag wiring harness from the sliding contact to the air bag module, then install the module to the steering wheel. Tighten the module retaining nuts to 35–53 inch lbs. (4–6 Nm) and the screws until secure.

NOTE: When the battery is disconnected and reconnected, some abnormal driving symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles (16 km) or more for the PCM to relearn the strategy.

13. Connect both battery cables to the battery. Verify that the air bag warning indicator is functioning properly.

Tie Rod Ends**REMOVAL AND INSTALLATION**

Except 1997 F-150 and Expedition Models

Inner and Outer Tie Rod Ends

1. Raise and support the front end on jackstands.

2. Place the wheels in a straight-ahead position.

3. Remove the ball stud from the pitman arm using a tie rod end remover.

4. Loosen the nuts on the adjuster sleeve clamp. Remove the ball stud from the adjuster, or the adjuster from the tie rod. Count the number of turns it takes to remove

the sleeve from the tie rod or ball stud from the sleeve.

To install:

5. Install the sleeve on the tie rod, or the ball in the sleeve the same number of turns noted during removal. Make sure the adjuster clamps are in the correct position, illustrated, and torque the clamp bolts to 40 ft. lbs. (54 Nm).

6. Keep the wheels straight ahead and install the ball studs. Torque the nuts to 75 ft. lbs. (102 Nm). Use new cotter pins.

7. Install the drag link and connecting rod.

8. Have the front end alignment checked.

1997 F-150 and Expedition Models**Outer Tie Rod End**

1. Break the front wheel lug nuts loose while the vehicle is resting on the ground.

2. Raise and safely support the front of the vehicle on jackstands.

3. Remove the tire and wheel assemblies.

4. Matchmark the outer tie rod end to the tie rod sleeve, and the tie rod sleeve to the inner tie rod end.

5. Remove the outer tie rod-to-steering knuckle cotter pin, then remove the castle nut from the outer tie rod ball joint stud.

6. Separate the outer tie rod end from the steering knuckle by using a Pitman arm puller, such as Ford Tool T64P-3590-F.

7. Loosen the outer tie rod sleeve jam nut, then, while counting the revolutions needed to remove, turn the outer tie rod end out of the sleeve.

8. Then, if necessary, loosen the inner tie rod sleeve jam nut, then, also while counting the revolutions needed to remove, turn the tie rod sleeve off of the inner tie rod.

To install:

9. Thread the tie rod sleeve onto the inner tie rod end threads. Turn the sleeve onto the inner tie rod the same number of turns as was needed during removal, then fine adjust the sleeve by aligning the matchmarks.

10. Tighten the inner tie rod sleeve jam nut to 57–77 ft. lbs. (77–104 Nm).

11. Thread the outer tie rod end into the sleeve threads. Turn the outer tie rod into the sleeve the same number of turns as was needed during removal, then fine adjust the outer tie rod end by aligning the matchmarks.

12. Tighten the outer tie rod sleeve jam nut to 57–77 ft. lbs. (77–104 Nm).

13. Install the outer tie rod ball joint stud into the steering knuckle,

then install and tighten the ball joint stud castle nut to 57–77 ft. lbs. (77–104 Nm). Install a new cotter pin through the castle nut's castellations and the ball joint studs hole; if the hole and any of the castellations do not line up, tighten the nut until they do.

14. Install the wheel and tire assembly. Install and tighten the lug nuts until snug.

15. Lower the vehicle until the front tires are touching the ground enough to hold them stationary, then tighten them in a star-shaped sequence to 83–112 ft. lbs. (113–153 Nm).

16. Lower the vehicle the rest of the way.

Inner Tie Rod End

1. Break the front wheel lug nuts loose while the vehicle is resting on the ground.

2. Raise and safely support the front of the vehicle on jackstands.

3. Remove the tire and wheel assemblies.

4. Matchmark the inner tie rod end to the tie rod sleeve.

5. Remove the inner tie rod-to-center link (drag link) cotter pin, then remove the castle nut from the inner tie rod ball joint stud.

6. Separate the inner tie rod end from the center link by using a Pitman arm puller, such as Ford Tool T64P-3590-F.

7. Loosen the inner tie rod sleeve jam nut, then, while counting the revolutions needed to remove, turn the inner tie rod end out of the sleeve.

To install:

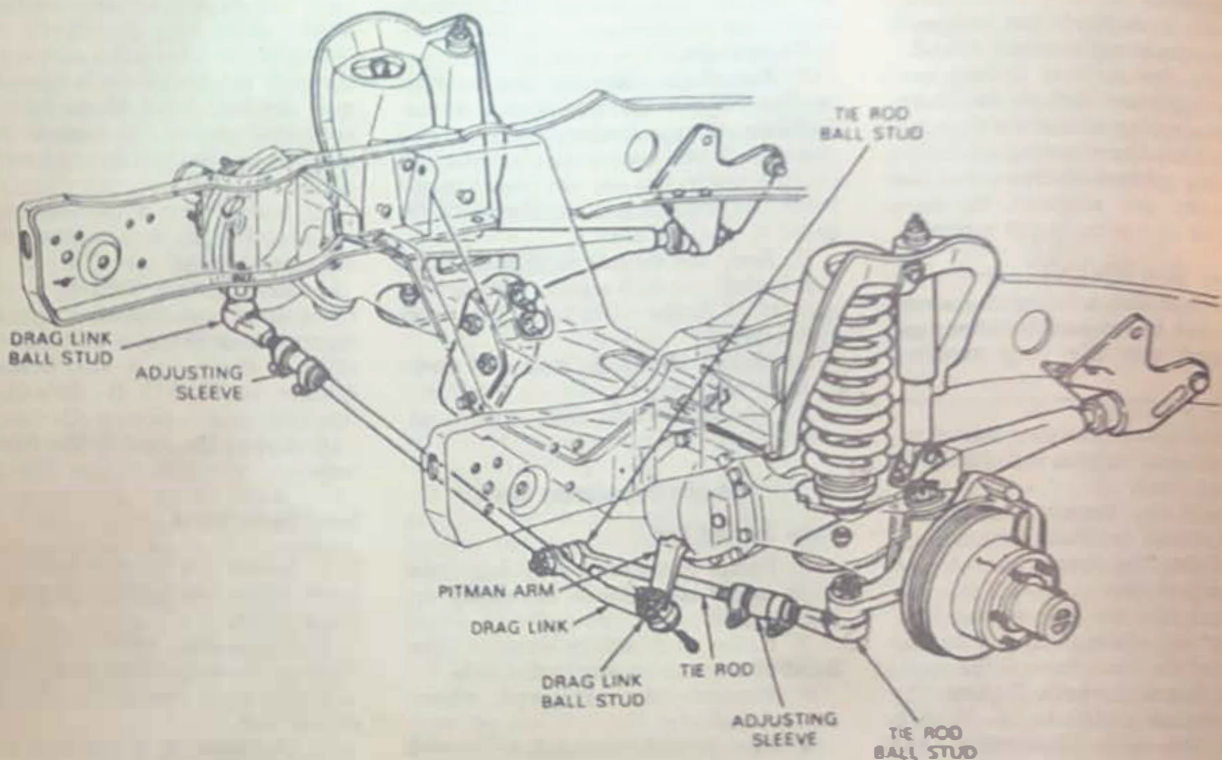
8. Thread the inner tie rod end into the sleeve threads. Turn the inner tie rod into the sleeve the same number of turns as was needed during removal, then fine adjust the inner tie rod end by aligning the matchmarks.

9. Tighten the inner tie rod sleeve jam nut to 57–77 ft. lbs. (77–104 Nm).

10. Install the inner tie rod ball joint stud into the center link, then install and tighten the ball joint stud castle nut to 57–77 ft. lbs. (77–104 Nm). Install a new cotter pin through the castle nut's castellations and the ball joint stud hole; if the hole and any of the castellations do not line up, tighten the nut until they do.

11. Install the wheel and tire assembly. Install and tighten the lug nuts until snug.

12. Lower the vehicle until the front tires are touching the ground enough to hold them stationary, then tighten them in a star-shaped se-



Steering Linkage — Bronco and 4WD 1993-96 F-150 models

quence to 83-112 ft. lbs. (113-153 Nm).

19. Lower the vehicle the rest of the way.

Power Steering Gear

ADJUSTMENT

Except F-Super Duty, Motor Home and 1997 F-150 and Expedition Models

The XR-50 Power Steering Gear is used on all 1993-97 models except for the 1993-97 F-Super Duty stripped chassis and motor home chassis, and the 1997 F-150 and Expedition models.

1. Raise and support the front end on jackstands.
2. Matchmark the pitman arm and gear housing.
3. Set the wheels in a straight-ahead position.
4. Disconnect the pitman arm from the sector shaft.
5. Disconnect the fluid RETURN line at the pump reservoir and cap the reservoir nipple.
6. Place the end of the return line in a clean container and turn the steering wheel lock-to-lock a few times to expel the fluid from the gear.

7. Turn the steering wheel all the way to the right stop. Place a small piece of masking tape on the steering wheel rim as a reference and rotate the steering wheel 45° from the right stop.

8. Disconnect the battery ground.

9. Remove the horn pad.

10. Using an inch-pound torque wrench on the steering wheel nut, record the amount of torque needed to turn the steering wheel 1/4 turn counterclockwise. The preload reading should be 4-9 inch lbs. (0.45-1.00 Nm).

11. Center the steering wheel (1/4 the total lock-to-lock turns) and record the torque needed to turn the steering wheel 90° to either side of center. On a vehicle with fewer than 5000 miles, the meshload should be 15-25 inch lbs. (1.68-2.80 Nm). On a vehicle with 5000 or more miles (8000 km), the meshload should be 7 inch lbs. (0.78 Nm) more than the preload torque. On vehicles with fewer than 5000 miles (8000 km), if the meshload is not within specifications, it should be reset to a figure 14-18 inch lbs. (1.57-2.02 Nm) greater than the recorded preload torque. On vehicles with 5000 or more miles (8000 km), if the meshload is not within specifications, it should be reset to a figure 10-14

inch lbs. (1.12-1.57 Nm) greater than the recorded preload torque.

12. If an adjustment is required, loosen the adjuster locknut and turn the sector shaft adjuster screw until the necessary torque is achieved.

13. Once adjustment is completed, hold the adjuster screw and tighten the locknut to 45 ft. lbs. (61 Nm).

14. Recheck the adjustment readings and reset if necessary.

15. Connect the return line and refill the reservoir.

16. Install the pitman arm.

17. Install the horn pad.

1997 F-150 and Expedition Models

NOTE: The engine should NOT be running for this test.

1. Turn the steering wheel from the right lock to the left lock at least once.

CAUTION

The residual power supply must be discharged before any air bag component is serviced.

2. Remove the driver side air bag as follows:

a. Disconnect the battery-to-starter relay cable for at least one minute to allow the Air Bag system backup power supply to discharge.

b. Remove the 4 air bag module retaining nuts (2 screws for 1997 F-150 and Expedition models) from the air bag module on the back side of the steering wheel, then lift the module away from the steering wheel.

c. Detach the air bag wiring harness connector, and remove the module from the steering wheel.

3. Raise and support the front of the vehicle safely on jackstands.

4. Remove the steering sector shaft arm drag link castle nut and cotter pin.

5. Using a Pitman arm puller, such as Ford Tool T65P-3590-F, separate the steering sector shaft arm from the drag link.

6. From inside the vehicle, attach an inch pound torque wrench to the steering wheel retaining bolt and measure the rotating torque required to turn the steering wheel 90 degrees from the center position. If the steering wheel requires more force than 13 inch lbs. (1.5 Nm), adjust the steering gear meshload as follows:

a. Hold the steering gear sector shaft and loosen the locknut.

b. Turn the sector shaft until the correct value is measured with the torque wrench at the steering wheel.

c. Hold the sector shaft and tighten the locknut to 19–26 ft. lbs. (26–35 Nm).

7. Install the steering sector shaft arm drag link, castle nut and cotter pin. Tighten the castle nut to 57–76 ft. lbs. (77–104 Nm).

8. Lower the vehicle.

9. Install the driver's side air bag as follows:

a. Route the air bag sliding contact wire harness through the steering wheel opening at the 3 o'clock position. Situate the steering wheel on the steering column shaft so that the matchmarks are aligned. Be sure that the air bag wire is not pinched.

WARNING

Be sure that the wiring does not get trapped between the steering wheel and the air bag sliding contact.

F-Super Duty and Motor Home Chassis

Adjustments must be made with the steering gear removed and mounted in a vise.

NOTE: Backlash is correct when a 4–18 inch lb. increase in rotational torque is noted at the

input shaft as it is rotated and the piston passes the mid-point of its total travel in the housing. The torque increase should occur only at mid-point and should disappear after mid-point.

1. Loosen the locknut and turn the adjusting screw counterclockwise as far as it will go.

2. Using an inch-pound torque wrench, rotate the input shaft as far as it will go in one direction, then, counting the number of full turns and noting the rotational torque, rotate it to the opposite stop.

3. Turn the shaft back $\frac{1}{2}$ the total number of turns to the mid-point.

4. Rotate the shaft 180° to both sides of the mid-point, noting the change in rotational torque. Turn the adjusting screw $\frac{1}{8}$ – $\frac{1}{4}$ turn at a time until the proper reading of 4–18 inch lb. increase in torque is noted over the mid-point. This increase in torque must be plus the total rotational torque.

5. When the adjustment is correct, hold the adjusting screw and, using a crow's foot adapter, torque the locknut to 74–88 ft. lbs. (100–120 Nm).

6. Check the adjustment to make sure it hasn't changed. Rotate the shaft through its entire travel. It must rotate smoothly.

REMOVAL AND INSTALLATION

Except F-Super Duty, Motor Home and 1997 F-150 and Expedition Models

The XR-50 Power Steering Gear is used on all 1993–97 models except for the 1993–97 F-Super Duty stripped chassis and motor home chassis, and the 1997 F-150 and Expedition models.

1. Raise and support the front end on jackstands.

2. Place the wheels in the straight-ahead position.

3. Place a drain pan under the gear and disconnect the pressure and return lines. Cap the openings.

4. Remove the splash shield from the flex coupling.

5. Disconnect the flex coupling at the gear.

6. Matchmark and remove the pitman arm from the sector shaft.

7. Support the steering gear and remove the mounting bolts.

8. Remove the steering gear. It may be necessary to work it free of the flex coupling.

To install:

9. Place the splash shield on the steering gear lugs.

10. Slide the flex coupling into place on the steering shaft. Make sure the steering wheel spokes are still horizontal.

11. Center the steering gear input shaft with the indexing flat facing downward.

12. Slide the steering gear input shaft into the flex coupling and into place on the frame side rail. Install the flex coupling bolt and torque it to 30–42 ft. lbs. (41–57 Nm).

13. Install the gear mounting bolts and torque them to 65 ft. lbs. (88 Nm).

14. Make sure the wheels are still straight ahead and install the pitman arm. Torque the nut to 170–288 ft. lbs. (231–392 Nm).

15. Connect the pressure, then, the return lines. Torque the pressure line to 25 ft. lbs. (34 Nm).

16. Snap the flex coupling shield into place.

17. Fill the steering reservoir.

18. Run the engine and turn the steering wheel lock-to-lock several times to expel air. Check for leaks.

1997 F-150 and Expedition Models

1. Raise and safely support the front of the vehicle with jackstands.

2. If equipped remove the undercarriage skid plate.

3. Remove the lower radiator air deflector by removing the 3 screws and 5 push clips.

4. Remove the steering sector shaft arm drag link cotter pin, then remove the castle nut.

5. Use a Pitman arm puller, such as T65P-3590-F, to separate the steering sector shaft arm drag link.

6. Remove the dust shield from the valve housing.

7. Remove the intermediate shaft pinch bolt.

8. Slide the intermediate shaft off the steering gear input shaft.

9. Disconnect the power steering fluid lines from the gear.

10. Remove the 3 steering gear bolts and the steering gear.

11. If the sector shaft arm must be removed to install on a new gear, mount the gear into a vise, then remove the sector shaft nut and lockwasher. Use the Pitman arm puller to draw the sector shaft arm off of the steering gear shaft.

To install:

12. If necessary, install the sector shaft arm on the steering gear shaft, then install the retaining nut and new lockwasher to 170–228 ft. lbs. (234–316 Nm).

5 FORD MOTOR CO. BRONCO/E-SERIES VAN/EXPEDITION

13. Situate the power steering gear in position, then install the 3 mounting bolts to 50–68 ft. lbs. (68–92 Nm).

14. Attach the power steering fluid lines to the steering gear, then tighten the fluid line fittings to 20–30 ft. lbs. (27–41 Nm).

15. Position the intermediate shaft onto the steering gear input shaft, then install the pinch bolt to 30–42 ft. lbs. (41–57 Nm).

16. Install the dust shield onto the valve housing.

17. Attach the drag link to the sector shaft arm, then install the castle nut to 57–76 ft. lbs. (77–104 Nm). Tighten the castle nut further until a castellation is aligned with the hole in drag link, then install a new cotter pin.

18. Install the lower radiator air deflector.

19. Install the undercarriage skid plate, if applicable.

20. Lower the vehicle.

F-Super Duty and Motor Home Chassis

1. Raise and support the front end on jackstands.

2. Thoroughly clean all connections.

3. Place a drain pan under the area.

4. Disconnect the hydraulic lines at the gear. Cap all openings at once.

5. Remove the retaining bolt and nut and disconnect the pitman arm from the sector shaft.

6. Remove the bolt and nut securing the input shaft and U-joint.

7. Support the gear and remove the gear-to-frame bolts and nuts.

To install:

8. Position the gear on the frame and install the bolts and nuts. Torque the nuts to 150–200 ft. lbs. (203–272 Nm).

9. Install the U-joint bolt and nut. Torque the nut to 50–70 ft. lbs. (68–95 Nm).

10. Install the pitman arm.

CAUTION

Never hammer the pitman shaft onto the sector shaft! Hammering will damage the gear. Use a cold chisel to separate the pitman arm opening.

11. Install the bolt and nut. Torque the nut to 220–300 ft. lbs. (299–408 Nm).

12. Connect the hydraulic lines, fill the reservoir, run the engine and check for leaks.

Power Steering Pump

SYSTEM BLEEDING

Except 1997 F-150 and Expedition Models

1. Fill the power steering fluid reservoir.

2. Disconnect the coil wire.

3. Crank the engine with the starter and continue adding fluid until the level remains constant. Do not prolong cranking as the battery may be drained and the starter damaged.

4. Rotate the steering wheel approximately 30 degrees each side of center while continuing to crank the engine.

5. Recheck the fluid level and fill, as required.

6. Reconnect the coil wire.

7. Start the engine and allow it to run for several minutes.

8. Rotate the steering wheel from stop to stop.

9. Shut off the engine and recheck the fluid level. Add fluid, as required.

10. If air is still trapped in the system, proceed as follows:

a. Fabricate a purging tool.

b. Make sure the reservoir fluid level is correct.

c. Insert the rubber stopper end of the fabricated purging tool tightly into the filler tube.

d. Connect a suitable length of hose to the purging tool. Connect the other end of the hose to an air conditioner vacuum pump or distributor machine. Do not use engine vacuum.

e. Start the engine and let it idle for approximately 15 minutes. Turn the steering wheel 1 full cycle every 5 minutes but do not hit the stops. This will assist in removing trapped air.

f. Stop the engine and disconnect the vacuum source. Remove the purging tool.

g. Check the fluid level and install the filler tube dipstick.

1997 F-150 and Expedition Models

1. Remove the ignition coil fuse (No. 30) to disable the vehicle.

2. Fill the power steering pump reservoir with MERCON approved fluid (XT-2-QDX) or equivalent.

3. Raise and support the front of the vehicle safely on jackstands.

4. Get an assistant to crank the engine with the starter motor while you add fluid until the level remains constant.

WARNING

Do not hold the steering wheel at either lock position for more than 5 seconds; damage to the steering pump may occur.

5. With the front wheels off of the ground and while cranking the engine, rotate the steering wheel from lock-to-lock.

6. Check the fluid level and add fluid if necessary.

7. Install the ignition fuse (No. 30) into the fuse block.

8. Start the engine and allow it to run for several minutes.

9. Lower the vehicle.

10. Rotate the steering wheel from lock-to-lock.

11. Turn the engine OFF and check the fluid level. Add fluid if necessary.

REMOVAL AND INSTALLATION

C-II Power Steering Pump

This pump is used by all models except the F-Super Duty stripped chassis and motor home models, and the 1997 F-150 and Expedition models.

1. Disconnect the return line at the pump and drain the fluid into a container.

2. Disconnect the pressure line from the pump.

3. Loosen the pump bracket nuts and remove the drive belt. On the 4.9L (VIN Y and Z) and 5.0L (VIN N) with a serpentine drive belt, remove belt tension by lifting the tensioner out of position.

4. Remove the nuts and lift out the pump/bracket assembly.

5. If a new pump or bracket is being installed, remove the pulley from the pump; use a press and adapters.

To install:

6. Position the steering pump on the engine and install the mounting fasteners. Tighten the fasteners to the following specifications:

- Pivot bolt (4.9L (VIN Y and Z) and 5.0L (VIN N)) — 45 ft. lbs. (61 Nm)

- Pump-to-adjustment bracket — 45 ft. lbs. (61 Nm)

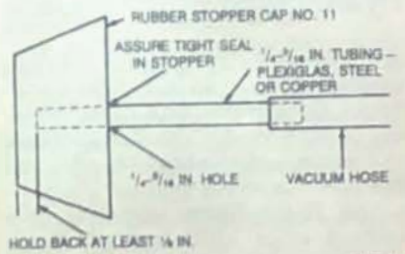
- Support bracket-to-engine (5.8L (VIN H and R)) — 65 ft. lbs. (88 Nm)

- Support bracket-to-water pump housing (4.9L (VIN Y and Z)) — 17 ft. lbs. (23 Nm)

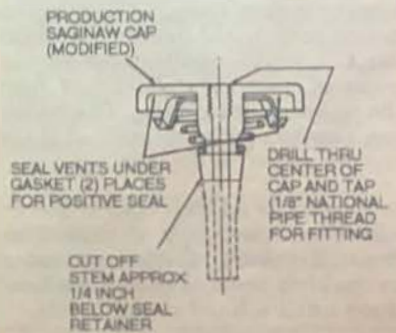
- Support bracket-to-water pump housing (5.0L (VIN N), 5.8L (VIN H and R)) — 45 ft. lbs. (61 Nm)

- Pressure line-to-fitting — 29 ft. lbs. (39 Nm)

- Adjustment bracket-to-support bracket:



Fabricated power steering system air purging tool — except 1997 F-150 and Expedition models



Modified pump reservoir cap — E Series

- 4.9L (VIN Y and Z), 5.0L (VIN N), 5.8L (VIN H and R) — 45 ft. lbs. (61 Nm)
- 7.5L (VIN G) and Diesel — Long bolt — 85 ft. lbs. (88 Nm)
- Short bolt — 45 ft. lbs. (61 Nm)
- 7. Install the accessory drive belt.
- 8. Attach the fluid lines to the pump, then bleed the hydraulic steering system.

C-III Power Steering Pump

The C-III steering pump is used on the 1997 F-150 and Expedition models.

1. Remove the engine air cleaner assembly.
2. Remove the accessory drive belt.
3. Disconnect the power steering reservoir pump hose from the power steering pump and drain the fluid into a large catch pan.
4. Disconnect the power steering pressure hose from the steering gear.
5. Remove the 2 top power steering pump bolts.
6. Raise and safely support the front of the vehicle on jackstands.
7. Remove the 2 lower pump bolts and remove the power steering pump from the engine.

8. Lower the vehicle.

9. If necessary, remove the power steering pressure hose fitting from the pump by holding the pump in a vise.

10. If necessary, remove the power steering pump pulley. Hold the Steering Pump Pulley Remover T69L-10300-B, or equivalent, and rotate the forcing bolt to remove the pulley from the pump.

To install:

11. If the pulley was removed, thread the forcing bolt into the power steering pump and turn the steering pump pulley replacer tool, or equivalent, to install the pump pulley.

12. Install a new power steering Teflon® seal onto the pressure hose fitting by stretching the Teflon® seal over the Teflon® seal replacer set D90P-3517-A, or equivalent, until it is large enough to slip over the tube nut.

13. Install the power steering pressure hose, then tighten the fitting to 20-30 ft. lbs. (27-41 Nm).

14. Position the steering pump and loosely install the 4 mounting bolts.

15. Tighten the 2 upper mounting bolts to 15-20 ft. lbs. (20-30 Nm).

16. Raise and support the front of the vehicle safely on jackstands.

17. Tighten the 2 lower mounting bolts to 15-20 ft. lbs. (20-30 Nm).

18. Lower the vehicle.

19. Install the other power steering pressure hose to the steering gear, then tighten to 13-17 ft. lbs. (17-23 Nm).

20. Connect the power steering reservoir pump hose to the power steering pump.

21. Fill and bleed the hydraulic power steering system.

ZF Power Steering Pump

The ZF power steering pump is used on the F-Super Duty stripped chassis and Motor Home models.

1. Disconnect the pressure line from the pump and tie up the ends of both hoses in a raised position. Cap the openings.

2. Loosen the pump pivot and adjusting bolts and remove the drive belt.

3. Remove the bolts and lift out the pump.

To install:

4. Install the pump in the vehicle.

5. Install the pivot bolt and nut finger-tight.

6. Install the accessory drive belt, then adjust the belt tension.

7. Tighten the mounting (pivot and adjusting) bolts to 30-45 ft. lbs. (41-61 Nm).

8. Connect the hoses, then refill the reservoir.

9. Bleed the system, then run the engine and check for leaks.

BRAKES

Anti-Lock Brake System Service

PRECAUTIONS

- Certain components within the Anti-Lock Brake System (ABS) are not intended to be serviced or repaired individually. Only those components with removal and installation procedures should be serviced.

- Do not use rubber hoses or other parts not specifically specified for and ABS system. When using repair kits, replace all parts included in the kit. Partial or incorrect repair may lead to functional problems and require the replacement of components.

- Lubricate rubber parts with clean, fresh brake fluid to ease assembly. Do not use lubricated shop air to clean parts; damage to rubber components may result.

- Use only specified brake fluid from an unopened container.

- If any hydraulic component or line is removed or replaced, it may be necessary to bleed the entire system.

- A clean repair area is essential.

Always clean the reservoir and cap thoroughly before removing the cap. The slightest amount of dirt in the fluid may plug an orifice and impair the system function. Perform repairs after components have been thoroughly cleaned; use only denatured alcohol to clean components. Do not allow ABS components to come into contact with any substance containing mineral oil; this includes used shop rags.

- The Anti-Lock control unit is a microprocessor similar to other computer units in the vehicle. Ensure that the ignition switch is OFF before removing or installing controller harnesses. Avoid static electricity discharge at or near the controller.

- If any arc welding is to be done on the vehicle, the control unit should be unplugged before welding operations begin.

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Master Cylinder

REMOVAL AND INSTALLATION

1. With the engine **OFF**, depress the brake pedal several times to expel any vacuum.
 2. Disconnect the fluid level warning switch wire.
 3. Disconnect the hydraulic system brake lines at the master cylinder.
 4. Remove the master cylinder retaining nuts and remove the master cylinder.
- To install:**
5. Position the master cylinder assembly on the booster and install the retaining nuts. Tighten the nuts to 18–25 ft. lbs. (25–34 Nm).
 6. Connect the hydraulic brake system lines to the master cylinder.
 7. Connect the wiring.
 8. Bleed the master cylinder.

BRAKE BOOSTER PUSHROD ADJUSTMENT

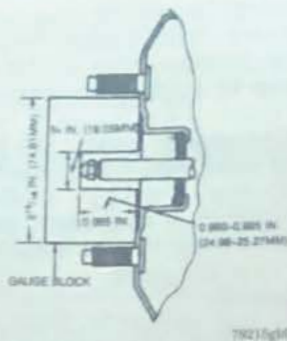
The pushrod has an adjustment screw to maintain the correct relationship between the booster control valve plunger and the master cylinder piston. If the plunger is too long it will prevent the master cylinder piston from completely releasing hydraulic pressure, causing the brakes to drag. If the plunger is too short it will cause excessive pedal travel and an undesirable clunk in the booster area. Remove the master cylinder for access to the booster pushrod.

To check the adjustment of the screw, place a gauge against the master cylinder mounting surface of the booster body. Adjust the pushrod screw by turning it until the end of the screw just touches the inner edge of the slot in the gauge. Install the master cylinder and bleed the system.

Diesel Brake Booster Vacuum Pump

The Diesel is equipped with a vacuum pump, which is driven by a single belt off of the alternator. This pump is located on the top right side of the engine.

Diesel pick-ups are also equipped with a low vacuum indicator switch which actuates the BRAKE warning lamp when available vacuum is below a certain level. The switch senses vacuum through a fitting in the vac-



Fabricate a template to adjust the power booster pushrod as shown

uum manifold that intercepts the vacuum flow from the pump. The low vacuum switch is mounted on the right side of the engine compartment, adjacent to the vacuum pump on F-250 and F-350 models.

NOTE: The vacuum pump cannot be disassembled. It is only serviced as a unit (the pulley is separate).

REMOVAL AND INSTALLATION

1. Remove the hose clamp and disconnect the pump from the hose on the manifold vacuum outlet fitting.
 2. Loosen the vacuum pump adjustment bolt and the pivot bolt. Slide the pump downward and remove the drive belt from the pulley.
 3. Remove the pivot and adjustment bolts and the bolts retaining the pump to the adjustment plate. Remove the vacuum pump and adjustment plate.
- To install:**
4. Install the pump-to-adjustment plate bolts and tighten to 11–18 ft. lbs. (15–25 Nm). Position the pump and plate on the vacuum pump bracket and loosely install the pivot and adjustment bolts.
 5. Connect the hose from the manifold vacuum outlet fitting to the pump and install the hose clamp.
 6. Install the drive belt on the pulley. Place a 3/8 in. drive breaker bar or ratchet into the slot on the vacuum pump adjustment plate. Lift up on the assembly until the proper belt tension is obtained. Tighten the pivot and adjustment bolts to 11–18 ft. lbs. (15–25 Nm).
 7. Start the engine and make sure the brake system functions properly.

NOTE: The BRAKE light will glow until brake vacuum builds up to the normal level.

Hydro-Boost Brake Booster

A hydraulically powered brake booster is used on the F-Series F-Series Super Duty truck. The power steering pump provides the fluid pressure to operate both the brake booster and the power steering gear.

The Hydro-Boost assembly contains a valve which controls pump pressure while braking, a lever to control the position of the valve and a boost piston to provide the force to operate a conventional master cylinder attached to the front of the booster. The Hydro-Boost also has a reserve system, designed to store sufficient pressurized fluid to provide at least 2 brake applications in the event of insufficient fluid flow from the power steering pump. The brakes can also be applied unassisted if the reserve system is depleted.

WARNING

Before removing the Hydro-Boost, discharge the accumulator by making several brake applications until a hard pedal is felt.

REMOVAL AND INSTALLATION

CAUTION

Do not depress the brake pedal with the master cylinder removed!

1. Remove the master cylinder from the Hydro-Boost unit. Do not disconnect the brake lines from the master cylinder! Position the master cylinder out of the way.
2. Disconnect the 3 hydraulic lines from the Hydro-Boost unit.
3. Disconnect the pushrod from the brake pedal.
4. Remove the booster mounting nuts and lift the booster from the firewall.

CAUTION

The booster should never be carried by the accumulator. The accumulator contains high pressure nitrogen and can be dangerous if mishandled! If the accumulator is to be disposed of, do not expose it to fire or other forms of incineration! Gas pressure can be relieved by drilling a 1/16 in. (1.5mm) hole in the end of the accumulator can. Always wear safety goggles during the drilling!

5. Installation is the reverse of removal. Tighten the booster mounting nuts to 25 ft. lbs. (34 Nm); the master cylinder nuts to 25 ft. lbs. (34 Nm).

connect the hydraulic lines, refill and bleed the booster as follows:

- a. Fill the pump reservoir with Dexron® II ATF.
- b. Disconnect the coil wires and crank the engine for several seconds.
- c. Check the fluid level and refill, if necessary.
- d. Connect the coil wires and start the engine.
- e. With the engine running, turn the steering wheel lock-to-lock twice. Shut off the engine.
- f. Depress the brake pedal several times to discharge the accumulator.
- g. Start the engine and repeat Step 5e.
- h. If foam appears in the reservoir, allow the foam to dissipate.
- i. Repeat Step 5e as often as necessary to expel all air from the system.

NOTE: The system is, in effect, self-bleeding and normal vehicle operation will expel any further trapped air.

Brake Caliper

REMOVAL AND INSTALLATION

Front Brake Calipers

Rail Slider Type

This brake system utilizes two press-in rails to retain the caliper, and on which the calipers slide to apply brake pressure to the rotors. This system is used by the following vehicles:

- 1993 models — Bronco, F-150, F-250, F-350, F-Super Duty, and E-150
- 1994 models — F-250, F-350 and F-Super Duty
- 1995-97 models — F-Super Duty

1. Raise and safely support the vehicle and remove the wheels.
2. Place an 8 in. (203mm) C-clamp on the caliper and tighten the clamp to bottom the caliper piston in the cylinder bore. Bear the clamp on the outer pad; never press directly on the piston! Remove the C-clamp.
3. Clean the excess dirt from around the caliper pin tabs.
4. Drive the upper caliper pin inward until the tabs on the pin touch the spindle.
5. Insert a small prybar into the slot provided behind the pin tabs on the inboard side of the pin.
6. Using needle nose pliers, compress the outboard end of the pin

while, at the same time, prying with the prybar until the tabs slip into the groove in the spindle.

7. Place the end of a $\frac{1}{8}$ in. (11mm) punch against the end of the caliper pin and drive the pin out of the caliper slide groove.

8. Repeat this procedure for the lower pin.

9. Lift the caliper off of the rotor.

10. Remove the brake pads from the caliper.

11. Disconnect the brake hose from the caliper, then plug the brake line to prohibit contamination of the brake fluid by water or dirt.

To install:

12. Connect the brake hose to the caliper. When connecting the brake fluid hose to the caliper, it is recommended that a new copper washer be used at the connection of the brake hose and caliper.

13. Thoroughly clean the areas of the caliper and spindle assembly which contact each other during the sliding action of the caliper.

14. Install the brake pads onto the caliper.

15. Position the caliper on the spindle assembly. Lightly lubricate the caliper sliding grooves with caliper pin grease.

16. Position the a new upper pin with the retention tabs next to the spindle groove.

NOTE: Don't use the bolt and nut with the new pin.

17. Carefully drive the pin, at the outboard end, inward until the tabs contact the spindle face.

18. Repeat the procedure for the lower pin.

WARNING

Don't drive the pins in too far, or it will be necessary to drive them back out until the tabs snap into place. The tabs on each end of the pin must be free to catch on the spindle sides!

19. Install the wheels.

Pin Slider Type

The calipers used on this brake system utilize two bolts, or pins, to retain the calipers to the anchor plates. The calipers slide on these bolts to apply force against the brake rotors. The following vehicles utilize this system of caliper retention:

- 1993 models — E-250 and E-350
- 1994 models — Bronco, F-150, E-150, E-250 and E-350
- 1995-97 models — Bronco, Expedition, F-150, F-250, F-350, E-150, E-250 and E-350

1. Break the front wheel lug nuts loose, then raise and support the front of the vehicle safely on jackstands.

2. Remove the front wheels.

3. Remove the front brake hose bolt, then remove the copper washers and plug the front brake hose.

4. Remove the 2 front disc brake caliper slide pins, then lift the caliper off of the front caliper anchor plate.

To install:

5. Install the front disc brake caliper onto the caliper anchor plate, then install the 2 slide pins. Tighten the slider pins/bolts to the following values:

- 1994-97 Bronco, F-150 and E-150 Models — 21-26 ft. lbs. (28-36 Nm)
- 1996-97 F-250, F-350, E-250 and E-350 Models — 141-190 ft. lbs. (191-259 Nm)
- 1995 F-250, F-350, E-250 and E-350 Models — 85-100 ft. lbs. (115-135 Nm)
- 1993-94 E-250 and E-350 Models — 85-100 ft. lbs. (115-135 Nm)

6. Using new copper washers, attach the front brake hose to the brake caliper, then install and tighten the retaining bolt to 23-29 ft. lbs. (30-40 Nm) for 1997 models, to 10-15 ft. lbs. (14-20 Nm) for 1993-96 models.

7. Bleed the brake system.

8. Clean the wheel hub mounting surface.

9. Install the front wheels and snug the lug nuts to fully seat the wheel against the hub.

10. Lower the vehicle until some of the vehicle's weight rests on the front tires, then tighten the lug nuts to 83-112 ft. lbs. (113-153 Nm).

11. Lower the vehicle completely.

12. Make sure that the brakes are operating correctly.

Rear Brake Caliper

The only Ford Trucks covered by this manual equipped with rear disc brakes are the 1995-97 F-Super Duty models (stripped chassis and motor home).

1. Remove sufficient brake fluid from the brake master cylinder reservoir to allow for pressing the caliper pistons into the bores. Discard the used brake fluid.

2. Raise and safely support the vehicle.

3. Remove the wheels.

4. Place an 8 in. (203mm) C-clamp on the caliper, with the clamp frame on the disc brake caliper and the clamp strew on the outboard brake shoes and lining backing plate, then tighten the clamp to press the caliper

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pistons in the cylinder bores only enough to give removal clearance. Remove the C-clamp.

5. Remove the rear brake hose-to-caliper flow bolt and discard the used copper washers. Plug the brake hose so that contamination of the brake fluid does not occur.

6. Using the Hydraulic Caliper Pin Remover D89T-2196-A, or equivalent, drive the upper and lower caliper locking pins out.

7. Remove the disc brake caliper from the vehicle.

To install:

8. If necessary, install the brake shoe and anti-rattle clip.

9. Position the disc brake caliper in the support bracket.

10. Lubricate the caliper locking pins with Ford Silicone Dielectric Compound D7AZ-19A331-A or equivalent.

11. Drive the locking pins into the caliper/support bracket assembly until the tabs at each end of the pin snap into place.

12. Using new copper washers, attach the rear brake hose to the disc brake caliper. Tighten the rear brake hose-to-caliper flow bolt to 22-29 ft. lbs. (30-39 Nm).

13. Install the wheel, then lower the vehicle.

NOTE: Check the brake fluid level in the brake master cylinder reservoir and maintain sufficient level to prevent air from entering the system.

14. Pump the brake pedal several times to drive the caliper pistons into contact with the brake shoe and lining.

15. Fill the brake master cylinder reservoir with new DOT 3 brake fluid.

16. Bleed the brake system and test the brakes for proper operation.

Disc Brake Pads

REMOVAL AND INSTALLATION

Front Brake Pads

NOTE: Never replace the pads on one side only! Always replace pads on both wheels as a set!

1. Break the front wheel lug nuts loose, then raise and support the front of the vehicle safely on jackstands.

2. Remove the front wheels.

3. Remove the front disc brake calipers.

4. Note the position and orientation of the brake pads and anti-rattle clip. Remove the brake shoes and linings from the front disc brake caliper anchor plate, then remove the anti-rattle clips.

To install:

5. Thoroughly clean the areas of the caliper and spindle assembly which contact each other during the sliding action of the caliper.

6. Place a new anti-rattle clip on the lower end of the inboard shoe. Make sure the tabs on the clip are positioned correctly and the loop-type spring is away from the rotor.

7. Place the lower end of the inner brake pad in the spindle assembly pad abutment, against the anti-rattle clip, and slide the upper end of the pad into position. Be sure the clip is still in position.

8. Check and make sure the caliper piston is fully bottomed in the cylinder bore. Use a large C-clamp, bearing on a piece of wood, to bottom the piston, if necessary.

9. Position the outer brake pad on the caliper, and press the pad tabs into place with your fingers. If the pad cannot be pressed into place by hand, use a C-clamp. Be careful not to damage the lining with the clamp. Bend the tabs to prevent rattling.

10. Lightly lubricate the caliper sliding grooves with caliper pin grease.

11. Install the brake caliper onto the anchor plate.

12. Bleed the brake system.

13. Clean the wheel hub mounting surface.

14. Install the front wheels and snug the lug nuts to fully seat the wheel against the hub.

15. Lower the vehicle until some of the vehicle's weight rests on the front tires, then tighten the lug nuts to 83-112 ft. lbs. (113-153 Nm).

16. Lower the vehicle completely.

17. Make sure that the brakes are operating correctly.



Installing anti-rattle clip on inner pad — single piston caliper — Bronco, F Series (Pick-Up) and E Series (Van)

Rear Brake Pads

NOTE: Never replace the pads on one side only! Always replace pads on both wheels as a set!

1. Remove the rear brake caliper from the rear hub without disconnecting the brake hose.

WARNING

Do not allow the caliper to hang by the brake hose.

2. Remove the brake pads and anti-rattle spring.

3. Thoroughly clean the areas of the caliper and caliper support assembly which contact each other during the sliding action of the caliper.

To install:

4. Position the brake shoes and anti-rattle clips on the disc brake caliper support bracket.

5. Install the rear disc brake caliper onto the rear support bracket.

6. Bleed the brake system.

7. Clean the wheel hub mounting surface.

8. Install the front wheels and snug the lug nuts to fully seat the wheel against the hub.

9. Lower the vehicle until some of the vehicle's weight rests on the front tires, then tighten the lug nuts to 83-112 ft. lbs. (113-153 Nm).

10. Lower the vehicle completely.

11. Make sure that the brakes are operating correctly.

Brake Rotor

REMOVAL AND INSTALLATION

Front Brake Rotor

Except 1997 F-150 and Expedition Models

1. Remove the front disc brake caliper and brake pads.

2. Remove the 2 front disc brake caliper anchor plate bolts, then lift the anchor plate off of the rotor.

3. Remove the hub grease cap.

4. Remove the cotter pin, then remove the locknut nut.

5. Remove the bearing retaining nut.

6. Remove the front wheel outer bearing retainer washer.

7. Remove the outer front wheel bearing.

8. Slide the front disc brake rotor off of the spindle.

9. Remove the bearing cone and roller. Discard the wheel hub grease seal.

10. On F-Super Duty models, the front disc brake rotor can be removed

from the wheel hub by removing the 10 Torx® machine screws.

To install:

11. On 4-wheel drive vehicles, position the front disc brake rotor on the hub, after cleaning the rotor with Ford Metal Brake Parts Cleaner F3AZ-19579-SA or equivalent. The machine screw threads must be coated with a suitable adhesive before attaching the front disc brake rotor to the wheel hub, then tighten the Torx® screws to 74-89 ft. lbs. (100-120 Nm).

12. Thoroughly clean and inspect the front wheel bearings and the front disc brake hub and rotor.

13. Lubricate the front wheel bearings with Premium Long-Life Grease Xg-1-C or -K, or equivalent.

14. Install the front inner wheel bearing, then press in a new inner wheel hub grease seal.

15. Position the front disc rotor and hub on the spindle.

16. Install the outer front wheel bearing into the rotor and hub.

17. Install the outer bearing retainer washer, then install the wheel bearing adjusting nut finger-tight.

NOTE: The front disc brake rotor should be rotated while adjusting the front wheel bearing end-play.

18. Tighten the wheel bearing adjusting nut to 30 ft. lbs. (40 Nm).

19. Loosen the spindle nut 2 complete revolutions (720 degrees).

20. Spin the rotor counterclockwise and tighten the spindle nut to 17-24 ft. lbs. (23-34 Nm).

21. Loosen the spindle nut just shy of 1/2 revolution (175 degrees).

22. Tighten the spindle nut 17 inch lbs. (2 Nm).

23. Install the retainer nut, a new cotter pin and the hub grease cap.

24. Position the front disc brake caliper anchor plate, then install the mounting bolts to 125-170 ft. lbs. (170-230 Nm).

25. Install the brake pads and brake caliper.

26. Bleed the brake system.

27. Clean the wheel hub mounting surface.

28. Install the front wheels and snug the lug nuts to fully seat the wheel against the hub.

29. Lower the vehicle until some of the vehicle's weight rests on the front tires, then tighten the lug nuts to 83-112 ft. lbs. (113-153 Nm).

30. Lower the vehicle completely.

31. Make sure that the brakes are operating correctly.

1997 F-150 and Expedition Models

1. Remove the front disc brake caliper and brake pads.

2. Remove the 2 front disc brake caliper anchor plate bolts, then lift the anchor plate off of the rotor.

3. On 4-wheel drive vehicles, slide the front disc brake rotor off of the front hub assembly.

4. On 2-wheel drive vehicles, remove the front disc rotor as follows:

a. Remove the hub grease cap.

b. Remove the cotter pin, then remove the retainer nut.

c. Remove the spindle nut.

d. Remove the front wheel outer bearing retainer washer.

e. Remove the outer front wheel bearing.

f. Slide the front disc brake rotor off of the spindle.

5. Remove the wheel hub grease seal and inner front wheel bearing.

To install:

6. On 4-wheel drive vehicles, position the front disc brake rotor on the hub, after cleaning the rotor with Ford Metal Brake Parts Cleaner F3AZ-19579-SA or equivalent.

7. On 2-wheel drive vehicles, install the rotor as follows:

a. Thoroughly clean and inspect the front wheel bearings and the front disc brake hub and rotor.

b. Lubricate the front wheel bearings with Premium Long-Life Grease Xg-1-C or -K, or equivalent.

c. Install the front inner wheel bearing, then press in a new inner wheel hub grease seal.

d. Position the front disc rotor and hub on the spindle.

e. Install the outer front wheel bearing into the rotor and hub.

f. Install the outer bearing retainer washer, then install the spindle nut finger-tight.

NOTE: The front disc brake rotor should be rotated while adjusting the front wheel bearing end-play.

g. Tighten the spindle nut to 30 ft. lbs. (40 Nm).

h. Loosen the spindle nut 2 complete revolutions (720 degrees).

i. Spin the rotor counterclockwise and tighten the spindle nut to 17-24 ft. lbs. (23-34 Nm).

j. Loosen the spindle nut just shy of 1/2 revolution (175 degrees).

k. Tighten the spindle nut 17 inch lbs. (2 Nm).

l. Install the retainer nut, a new cotter pin and the hub grease cap.

8. Position the front disc brake caliper anchor plate, then install the

mounting bolts to 125-170 ft. lbs. (170-230 Nm).

9. Install the brake pads and brake caliper.

10. Bleed the brake system.

11. Clean the wheel hub mounting surface.

12. Install the front wheels and snug the lug nuts to fully seat the wheel against the hub.

13. Lower the vehicle until some of the vehicle's weight rests on the front tires, then tighten the lug nuts to 83-112 ft. lbs. (113-153 Nm).

14. Lower the vehicle completely.

15. Make sure that the brakes are operating correctly.

Rear Brake Rotor

1. Raise and safely support the vehicle. Remove the wheel.

2. Remove the caliper assembly and support it to the frame with a piece of wire without disconnecting the brake fluid hose.

3. Remove the axle shaft.

NOTE: Press in on the tool to disengage the nut ratchet.

4. Remove the wheel bearing hub nut using the Hub Locknut Wrench T88T-4252-A, or equivalent, so that the drive tangs engage the four slots of the hub nut.

5. Remove the outer wheel bearing cone and roller.

6. Protect the rear axle spindle threads with cardboard tubing, tape or equivalent.

7. Remove the rear hub and rotor assembly using care not to damage the rear axle spindle threads.

8. With the rotor facing upward, secure the rear hub and rotor assembly in a vise with protective jaw caps.

9. Remove the 10 rotor-to-rear hub bolts and remove the rotor from the rear hub.

To install:

10. Position the rotor on the rear hub, then install the 10 rotor-to-rear hub bolts to 84-112 ft. lbs. (113-153 Nm).

11. Protect the rear axle spindle threads with cardboard tubing or tape.

12. Carefully position the rear hub and rotor assembly on the rear axle spindle, then remove the thread protection.

13. Install the outer wheel bearing cone and roller, then start the bearing hub nut making sure that the hub nut tab is properly located in the keyway prior to thread engagement.

14. Rotate the hub occasionally while tightening to seat the bearings. Position the Hub Locknut Wrench T88T-4252-A, or equivalent, so that the drive tangs of the tool engage the four slots of the nut. Apply inward pressure to the socket to separate the ratcheting components of the nut, then tighten the nut to 65-75 ft. lbs. (88-102 Nm). Back the nut off 90 degrees ($\frac{1}{4}$ turn), then retighten to 15-20 ft. lbs. (20-27 Nm).

15. Prior to installation of the axle shaft, clean and remove any debris in the hub bolt holes.

16. Inspect the axle shaft for cracked material around the holes and for oversized holes. Replace the axle shaft if these conditions are found.

17. Install the axle shaft and rear wheel gasket.

WARNING

Do not tighten the axle shaft-to-rear hub bolts until the lug nuts are tightened to specification.

18. Using new axle shaft-to-rear hub bolts, coat the bolt threads with a suitable thread adhesive and install the bolts only until they seat.

19. Install the disc brake caliper.

20. Install the wheels. Tighten the lug nuts until snug.

21. Lower the vehicle, then tighten the lug nuts to 140 ft. lbs. (190 Nm).

22. Tighten the axle shaft-to-rear hub bolts to 84-113 ft. lbs. (113-153 Nm).

Brake Drums

REMOVAL AND INSTALLATION

1. Relieve tension on the parking brake system by pulling on the front parking brake cable and conduit, then inserting a thin pry tool into the bottom hole of the parking brake pedal assembly to hold the pedal in place.

2. Raise and safely support the vehicle. Remove the wheel and tire assembly.

3. Remove the spring retaining nuts, if equipped, and remove the brake drum.

4. If the brake drum will not come off, insert a narrow prybar through the brake adjusting hole in the backing plate and disengage the adjusting lever from the adjusting screw. While holding the adjusting lever away from the adjusting screw, loosen the adjusting screw with a brake adjusting tool.

5. Inspect the brake drum surface for wear, scoring and runout. Machine or replace, as necessary.

To install:

6. Before installing a new brake drum, be sure to remove any protective coating with carburetor degreaser.

7. Slide the brake drum onto the wheel lug studs until completely seated against the brake assembly.

8. If applicable, install new push retaining nuts on the lug studs to secure the drum in position.

9. Adjust the rear brake drums so that a slight drag can be felt against the drum.

10. Install the rear wheels, then lower the vehicle.

11. Remove the thin pry tool from the parking brake pedal assembly.

12. Test the brakes to ensure they are functioning correctly.

ADJUSTMENT

Drum Installed

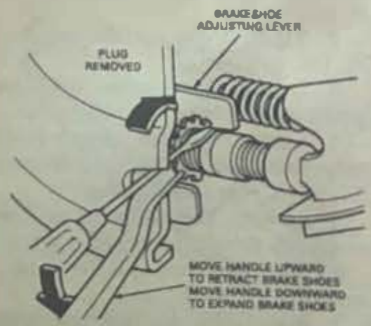
1. Raise and safely support the vehicle.

2. Remove the rubber plug from the adjusting slot on the backing plate.

3. Insert a brake adjusting spoon into the slot and engage the lowest possible tooth on the starwheel. Move the end of the brake spoon downward to move the starwheel upward and expand the adjusting screw. Repeat this operation until the brakes lock the wheels.

4. Insert a small prybar or piece of firm wire (coat hanger wire) into the adjusting slot and push the automatic adjusting lever out and free of the starwheel on the adjusting screw and hold it there.

5. Engage the topmost tooth possible on the starwheel with the brake adjusting spoon. Move the end of the adjusting spoon upward to move the adjusting screw starwheel downward.



Adjust the brake shoes in, if the rear brake drum will not slide off the brake assembly

and contract the adjusting screw. Back off the adjusting screw starwheel until the wheel spins freely with a minimum of drag. Keep track of the number of turns that the starwheel is backed off, or the number of strokes taken with the brake adjusting spoon.

6. Repeat this operation for the other side. When backing off the brakes on the other side, the starwheel adjuster must be backed off the same number of turns to prevent side-to-side brake pull.

7. When the brakes are adjusted make several stops while backing the vehicle, to equalize the brakes at both of the wheels.

8. Remove the safety stands and lower the vehicle. Road test the vehicle.

Drum Removed

1. Make sure the shoe-to-contact pad areas are clean and properly lubricated.

2. Using an inside caliper check the inside diameter of the drum. Measure across the diameter of the assembled brake shoes, at their widest point.

3. Turn the adjusting screw so the diameter of the shoes is 0.030 in. (0.76mm) less than the brake drum inner diameter.

4. Install the drum.

Brake Shoes

REMOVAL AND INSTALLATION

Bronco, F-150 and E-150 Models

1. Raise and safely support the vehicle. Remove the wheel and tire assembly and the brake drum.

2. Pull backward on the adjusting lever cable to disengage the adjusting lever from the adjusting screw. Move the outboard side of the adjusting screw upward and back off the pivot nut as far as it will go.

3. Pull the adjusting lever, cable and automatic adjuster spring down and toward the rear to unhook the pivot hook from the large hole in the secondary shoe web. Do not pry the pivot hook from the hole.

4. Remove the automatic adjuster spring and adjusting lever.

5. Remove the secondary shoe-to-anchor spring using a suitable brake spring removal/installation tool. Using the tool, remove the primary shoe-to-anchor spring and unhook the cable anchor. Remove the anchor pin plate, if equipped.

6. Remove the cable guide from the secondary shoe.

7. Remove the shoe hold-down springs, shoes, adjusting screw, pivot nut and socket. Note the color and position of each hold-down spring so they can be reassembled in the same position.

8. Remove the parking brake link and spring. Disconnect the parking brake cable from the parking brake lever.

9. Remove the secondary brake shoe. On 9 in. rear brakes, remove the parking brake lever from the shoe. On 10 in. rear brakes, remove the retainer clip and spring washer and remove the parking brake lever.

To install:

10. Clean the backing plate ledge pads and sand lightly. Apply a light coating of high temperature lithium grease to the points where the brake shoes touch the backing plate. Lubricate the adjusting cable eye and the anchor pin area.

11. Install the parking brake lever on the secondary shoe. On 10 in. brakes, secure with the spring washer and retaining clip.

12. Position the brake shoes on the backing plate and install the hold-down spring pins, springs and cups. Install the parking brake link, spring and washer. Connect the parking brake cable to the parking brake lever.

13. Install the anchor pin plate, if equipped, and place the cable anchor over the anchor pin with the crimped side toward the backing plate.

14. Install the primary shoe-to-anchor spring using the brake spring removal/installation tool.

15. Install the cable guide on the secondary shoe with the flanged hole fitted into the hole in the secondary

shoe. Thread the cable around the cable guide groove.

NOTE: Make sure the cable is positioned in the groove and not between the guide and shoe web.

16. Install the secondary shoe-to-anchor (long) spring.

NOTE: Make sure the cable end is not cocked or binding on the anchor pin when installed. All parts should be flat on the anchor pin.

17. Apply high temperature lithium grease to the threads and the socket end of the adjusting screw. Turn the adjusting screw into the adjusting pivot nut to the end of the threads and then loosen, $\frac{1}{2}$ turn.

18. Place the adjusting socket on the screw and install the assembly between the shoe ends with the adjusting screw nearest the secondary shoe.

NOTE: Be sure to install the adjusting screw on the same side of the vehicle from which it came. To prevent incorrect installation, the socket end of each adjusting screw is stamped with R or L, to indicate installation on the right or left side of the vehicle. The adjusting pivot nuts have lines machined around the body of the nut, 2 lines indicating the right side nut and 1 line indicating the left side nut.

19. Hook the cable hook into the hole in the adjusting lever from the outboard plate side. The adjusting levers are also stamped with an R or L to indicate right or left side installation.

20. Place the hooked end of the adjuster spring in the large hole in the primary shoe web and connect the loop end of the spring to the adjuster lever hole.

21. Pull the adjuster lever, cable and automatic adjuster spring down toward the rear to engage the pivot hook in the large hole in the secondary shoe web.

22. After installation, check the action of the adjuster by pulling the section of the cable between the cable guide and the adjusting lever toward the secondary shoe web far enough to lift the lever past a tooth on the adjusting screw wheel. The lever should snap into position behind the next tooth and releasing the cable should cause the adjuster spring to return the lever to its original position. This return action will turn the adjusting screw 1 tooth.

23. If pulling the cable does not produce the action described in Step 22 or if lever action is sluggish instead of positive and sharp, check the position of the lever on the adjusting screw toothed wheel. With the brake in a vertical position, anchor at the top, the lever should contact the adjusting wheel 1 tooth above the center line of the adjusting screw. If the contact point is below the center line, the lever will not lock on the adjusting screw wheel teeth and the screw will not turn as the lever is actuated by the cable.

24. To find the cause of the condition described in Step 23, proceed as follows:

a. Check the cable and fittings. The cable should completely fill or extend slightly beyond the crimped section of the fittings. If this does not happen, the cable assembly may be damaged and should be replaced.

b. Check the cable guide for damage. The cable groove should be parallel to the shoe web and the body of the guide should lie flat against the web. Replace the guide if it shows damage.

c. Check the pivot hook on the lever. The hook surfaces should be square with the body on the lever for proper pivoting. Repair the hook or replace the lever if the hook shows damage.

d. Be sure the adjusting screw socket is properly seated in the notch in the shoe web.

25. Adjust the brake shoes using either a brake adjustment gauge or manually with the drums installed.

26. If using a brake adjustment gauge, proceed as follows:

a. Measure the inside diameter of the brake drum with the gauge.

b. Reverse the tool and adjust the brake shoes until they touch the gauge. The gauge contact points on the shoes must be parallel to the vehicle with the center line through the center of the axle.

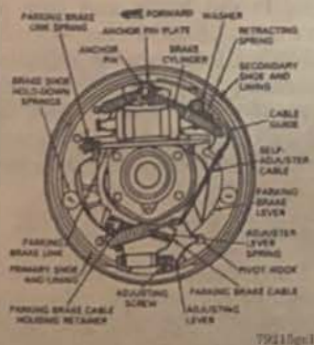
c. Install the drum and wheel and tire assembly. Lower the vehicle.

d. Apply the brakes sharply several times while driving the vehicle in reverse. Check brake operation by making several stops while driving forward.

27. If manually adjusting the brakes, proceed as follows:

a. Install the brake drum and wheel and tire assembly.

b. Remove the cover from the adjusting hole at the bottom of the backing plate and turn the adjust-



Rear brake shoe assembly —
Bronco, F-150 and E-150

ing screw, using a suitable brake adjusting tool, to expand the brake shoes until they drag against the brake drum.

c. When the shoes are against the drum, insert a narrow prybar through the brake adjusting hole and disengage the adjusting lever from the adjusting screw. While holding the adjusting lever away from the adjusting screw, loosen the adjusting screw with the brake adjusting tool, until the drum rotates freely without drag.

d. Install the adjusting hole cover and lower the vehicle.

e. Apply the brakes. If the pedal travels more than halfway to the floor, there is too much clearance between the brake shoes and drums. Repeat the adjustment procedure.

F-250, F-350, E-250 and E-350 Models

1. Raise and support the vehicle.
2. Remove the wheel and drum.
3. Remove the parking brake lever assembly retaining nut from behind the backing plate and remove the parking brake lever assembly.
4. Remove the adjusting cable assembly from the anchor pin, cable guide, and adjusting lever.
5. Remove the brake shoe retracting springs.
6. Remove the brake shoe hold-down spring from each shoe.
7. Remove the brake shoes and adjusting screw assembly.
8. Disassemble the adjusting screw assembly.
9. Clean the ledge pads on the backing plate. Apply a light coat of Lubriplate® to the ledge pads (where the brake shoes rub the backing plate).

To install:

10. Apply Lubriplate® to the adjusting screw assembly and the hold-down and retracting spring contacts on the brake shoes.

11. Install the upper retracting spring on the primary and secondary shoes and position the shoe assembly on the backing plate with the wheel cylinder pushrods in the shoe slots.

12. Install the brake shoe hold-down springs.

13. Install the brake shoe adjustment screw assembly with the slot in the head of the adjusting screw toward the primary shoe, lower retracting spring, adjusting lever spring, adjusting lever assembly, and connect the adjusting cable to the adjusting lever. Position the cable in the cable guide and install the cable anchor fitting on the anchor pin.

14. Install the adjusting screw assemblies in the same locations from which they were removed. Interchanging the brake shoe adjusting screws from one side of the vehicle to the other will cause the brake shoes to retract rather than expand each time the automatic adjusting mechanism is operated. To prevent incorrect installation, the socket end of each adjusting screw is stamped with an R or an L to indicate their installation on the right or left side of the vehicle. The adjusting pivot nuts can be distinguished by the number of lines machined around the body of the nut. Two lines indicate a right hand nut; one line indicates a left hand nut.

15. Install the parking brake assembly in the anchor pin and secure with the retaining nut behind the backing plate.

16. Adjust the brakes before installing the brake drums and wheels. Install the brake drums and wheels.

17. Lower the vehicle and road test the brakes. New brakes may pull to one side or the other before they are seated. Continued pulling or erratic braking should not occur.

Wheel Cylinder

REMOVAL AND INSTALLATION

1. Raise and safely support the vehicle. Remove the wheel and tire assembly, brake drum and brake shoes.
2. Remove the cylinder-to-shoe connecting pins.
3. Disconnect the brake line from the wheel cylinder. Plug the brake lines immediately after removal so that contamination of the brake fluid does not occur.
4. Remove the wheel cylinder retaining bolts and remove the cylinder from the brake backing plate.

To install:

5. Position the wheel cylinder against the backing plate, then install the mounting bolts. Tighten mounting bolts to 11-19 ft. (15-26 Nm).

6. Attach the brake line to wheel cylinder. Tighten the fitting 10-14 ft. lbs. (15-20 Nm).

7. Install the wheel cylinder brake shoe connecting pins, then install the brake shoes and other components.

8. Install the brake drum, then just the brake shoes.

9. Install the wheels and lower vehicle.

10. Bleed the brake system.

Parking Brake Cable

ADJUSTMENT

System Adjustment

Except F-Super Duty, and 1997 F-150 and Expedition Models

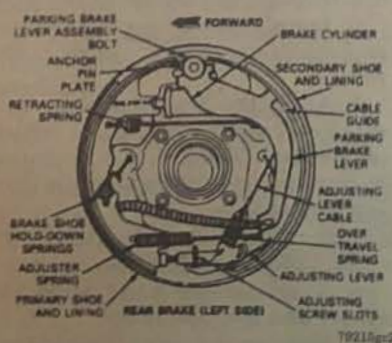
NOTE: Adjust the drum brake before adjusting the parking brake.

1. Raise and safely support the vehicle.
2. The brake drums should be cold.
3. Make sure the parking brake pedal is fully released.
4. While holding the tension equalizer, tighten the equalizer nut full turns past its original position.
5. Fully depress the parking brake pedal. Using a cable tension gauge check rear cable tension. Cable tension should be at least 350 lbs. (157 kg).
6. Fully release the parking brake. No drag should be noted at the wheels.

7. If drag is noted on F-250 and F-350 models, remove the drums and adjust the clearance between the parking brake lever and cam plate. Clearance should be 0.015 in. (0.38mm). Clearance is adjusted by the parking brake equalizer adjusting nut. If the tension limiter on the F-150 and Bronco doesn't release the drag, the tension limiter will have to be replaced.

F-Super Duty

1. Fully release the brake pedal.
2. Spray penetrating oil on the adjusting clevis, jam nut and threaded end of the cable.
3. Loosen the jam nut and remove the locking pin from the clevis.



Rear brake shoe assembly — F-250, F-350, E-250 and E-350

4. Back off on the clevis until there is slack in the cable.

5. Screw on the clevis until the pin can be inserted while the lever and cable are held tightly in the applied position. Then, remove the pin, let go of the cable and lever, and turn the clevis 10 full turns counterclockwise (loosen).

6. Install the pin.

1997 F-150 and Expedition Models

The 1997 F-150 and Expedition models utilize fully self-adjusting parking brake assemblies and do not require manual adjustment.

Initial Adjustment

NOTE: Use this procedure when a new tension limiter is installed.

Except F-Super Duty, and 1997 F-150 and Expedition Models

1. Raise and safely support the vehicle.

2. Depress the parking brake pedal fully.

3. Hold the tension limiter, install the equalizer nut and tighten it to a point $2\frac{1}{2}$ in. $\pm$ $\frac{1}{8}$ in. (63.5mm $\pm$ 3mm) up the rod.

4. Check to make sure the cinch strap has $1\frac{1}{2}$ in. (35mm) remaining.

1997 F-150 and Expedition Models

The 1997 F-150 and Expedition models utilize fully self-adjusting parking brake assemblies and do not require manual adjustment.

Field Adjustment

Except 1997 F-150 and Expedition Models

NOTE: Use this procedure to correct a slack system if a new tension limiter is not installed.

1. Apply the parking brake pedal to the fully engaged position.

2. Raise and safely support the vehicle, as necessary. Grip the threaded

rod to keep it from spinning and tighten the equalizer nut 6 full turns past its original position on the threaded rod.

3. Attach a suitable cable tension gauge in front of the equalizer assembly on the front cable and measure the cable tension. The cable tension should be 400-600 lbs. (181-272 kg) with the parking brake pedal in the last detent position. If tension is low, repeat Steps 2 and 3.

4. Release parking brake and check for rear wheel drag. There should be no brake drag.

1997 F-150 and Expedition Models

The 1997 F-150 and Expedition models utilize fully self-adjusting parking brake assemblies and do not require manual adjustment.

REMOVAL AND INSTALLATION

Except F-Super Duty, and 1997 F-150 and Expedition Models

Parking Brake Control

1. Raise and safely support the vehicle.

2. Loosen the adjusting nut at the equalizer.

3. Working in the engine compartment, remove the nuts attaching the parking brake control to the firewall.

4. Remove the cable from the control assembly clevis by compressing the conduit end prongs.

5. Installation is the reverse of removal. Torque the attaching nuts to 15 ft. lbs. (20 Nm).

Equalizer-To-Control Assembly Cable

1. Raise and safely support the vehicle.

2. Back off the equalizer nut and disconnect the cable from the tension limiter.

3. Remove the parking brake cable from the mount.

4. Disconnect the forward end of the cable from the control assembly.

5. Using a cord attached to the upper end of the cable, pull the cable from the vehicle.

6. Installation is the reverse of removal. Adjust the parking brake.

Equalizer-To-Rear Wheel Cable

1. Raise and safely support the vehicle.

2. Remove the wheels and brake drums.

3. Remove the tension limiter.

4. Remove the locknut from the threaded rod and disconnect the cable from the equalizer.

5. Disconnect the cable housing from the frame bracket and pull the cable and housing out of the bracket.

6. Disconnect the cables from the brake backing plates.

7. With the spring tension removed from the lever, lift the cable out of the slot in the lever and remove the cable through the backing plate hole.

8. Installation is the reverse of removal. On the F-250 and F-350, check the clearance between the parking brake operating lever and the cam plate. Clearance should be 0.015 in. (0.38mm) with the brakes fully released.

9. Adjust the brakes.

F-Super Duty

NOTE: To replace the brake shoes, or any other component, the parking brake cable must be disconnected.

1. Place the transmission in gear.

2. Fully release the parking brake pedal.

3. Raise and safely support the vehicle.

4. Disconnect the speedometer cable.

5. Spray penetrating oil on the adjusting clevis, jam nut and threaded end of the cable.

6. Loosen the jam nut and remove the locking pin from the clevis pin.

7. Remove the clevis pin, clevis and jam nut from the cable.

8. Remove the cable from the bracket on the case.

9. Matchmark the driveshaft and disconnect it from the flange.

10. Remove the 6 hex-head bolts securing the parking brake unit to the transmission extension housing and lift off the unit.

NOTE: The unit is filled with Ford Type H automatic transmission fluid.

To install:

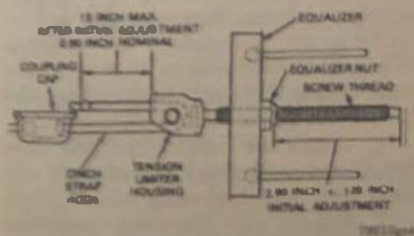
11. Refill the unit through the filler plug to the bottom of the plug hole. Install the plug and tighten it to 45 ft. lbs. (61 Nm).

12. Position the unit on the extension housing using 2 guide pins.

13. Using 6 NEW hex-bolts, attach the unit and torque the bolts to 40 ft. lbs. (54 Nm).

14. Connect the driveshaft and torque the bolts to 20 ft. lbs. (27 Nm).

15. Assemble the cable components. Screw on the clevis until the pin can be inserted while the lever and cable are held tightly in the applied position. Then, remove the pin, let go of the cable and lever, and turn the



Parking brake cable tension limiter assembly -- except F-Super Duty, and 1997 F-150 and Expedition models

clevis 10 full turns counterclockwise (loosen).

16. Install the pin.

1997 F-150 and Expedition Models

Front Cable and Pedal Assembly

NOTE: Make certain that the parking brake control is fully released.

1. Pull the front parking brake cable and conduit, then insert a thin pry tool into the hole on the bottom of the parking brake pedal assembly to hold it in the released position.

2. Disconnect the front cable from the cable equalizer, located under the left-hand side of the truck.

3. Remove the front door scuff plate, then remove the left-hand cowl side trim panel.

4. Remove the lower instrument panel steering column cover.

5. Remove the parking brake remote release screw and route the release handle through the opening in the instrument panel.

6. Remove the parking brake pedal assembly as follows:

a. Detach the parking brake signal switch connector.

b. Remove the 3 parking brake control nuts.

c. Separate the parking brake control from the parking brake control mounting bracket.

7. Disconnect the front cable and conduit from the parking brake pedal assembly.

8. Pry the parking brake cable rubber seal from the front floor pan, then compress the retainer and release the front cable and conduit from the bracket.

9. Remove the front cable and conduit.

To install:

10. Route the front cable and conduit into the vehicle, then push the cable/conduit into the bracket until it snaps in place.

11. Push the rubber seal back into place in the floor pan.

12. Attach the parking brake cable and conduit to the pedal assembly.

13. Position the parking brake pedal assembly in place, then install the retaining nuts to 11-15 ft. lbs. (15-20 Nm).

14. Attach the parking brake signal switch connector to the pedal assembly.

15. Install the parking brake remote release screw and route the release handle through the opening in the instrument panel.

16. Install the lower instrument panel steering column cover.

17. Install the left-hand cowl side trim panel.

18. Install the front door scuff plate.

19. Attach the front parking brake cable to the cable equalizer.

20. Release the thin pry tool from the parking brake pedal assembly. Apply and release the parking brake a few times to allow it to self-adjust.

Rear Cable

NOTE: Make certain that the parking brake control is fully released.

1. Pull the front parking brake cable and conduit, then insert a thin pry tool into the hole on the bottom of the parking brake pedal assembly to hold it in the released position.

2. Pull the front parking brake rear cable and conduit, then disconnect the cable equalizer.

3. Compress the retainer and release the rear parking brake rear cable and conduit from the bracket.

4. Raise and support the rear of the vehicle safely on jackstands.

5. Unclip the rear parking brake rear cable and conduit.

6. Remove the rear brake shoes and related components, including the parking brake lever.

7. Remove the rear cable from the backing plate by removing the cable end spring, compressing the retainers (using an aptly-sized box end wrench for this works extremely well), then pulling the rear cable out of the backing plate hole.

To install:

8. Route the rear cable through the backing plate hole and push it in until the retainers engage fully. Install the cable end spring, then install the rear brake components making sure to install the cable end to the brake lever prior to assembly.

9. Route the cable and conduit along the original path, clipping it to the various retainers along the way.

10. Attach the rear cable to the equalizer.

11. Lower the vehicle, then remove the thin pry tool from the brake pedal assembly.

12. Apply and release the parking brake a few times to ensure that it is functioning correctly.

Brake Hydraulic System

BLEEDING

When any part of the hydraulic system has been disconnected for repair

or replacement, air may get into the lines and cause spongy pedal action (because air can be compressed and brake fluid cannot). To correct this condition, it is necessary to bleed the hydraulic system after it has been properly connected to be sure all air is expelled from the brake cylinders and lines.

When bleeding the brake system, bleed one brake cylinder at a time beginning at the cylinder with the longest hydraulic line (farthest from the master cylinder) first. Keep the master cylinder reservoir filled with brake fluid during bleeding operation. Never use brake fluid that has been drained from the hydraulic system, no matter how clean it is.

It will be necessary to centralize the pressure differential valve after a brake system failure has been corrected and the hydraulic system has been bled.

The primary and secondary hydraulic brake systems are individual systems and are bled separately. During the entire bleeding operation, do not allow the reservoir to run dry. Keep the master cylinder reservoirs filled with brake fluid.

Wheel Cylinders and Calipers

1. Clean all dirt from around the master cylinder fill cap, remove the cap and fill the master cylinder with brake fluid until the level is within $\frac{1}{4}$ in. (6mm) of the top of the edge of the reservoir.

2. Clean off the bleeder screws at the wheel cylinders and calipers.

3. Attach the length of rubber hose over the nozzle of the bleeder screw at the wheel to be done first. Place the other end of the hose in a glass jar, submerged in brake fluid.

4. Open the bleed screw valve $\frac{1}{2}$ - $\frac{3}{4}$ turn.

5. Have an assistant slowly depress the brake pedal. Close the bleeder screw valve and have your assistant slowly return the brake pedal. Continue this pumping action to force any air out of the system. When bubbles cease to appear at the end of the bleeder hose, close the bleed valve and remove the hose.

6. Check the master cylinder fluid level and add fluid accordingly. Do this after bleeding each wheel.

7. Repeat the bleeding operation at the remaining 3 wheels in the following order: right-hand rear, left-hand rear, right-hand front, left-hand front. Fill the master cylinder reservoir.

Master Cylinder

1. Fill the master cylinder reservoirs.
2. Place absorbent rags under the fluid lines at the master cylinder.
3. Have an assistant depress and hold the brake pedal.
4. With the pedal held down, slowly crack open the hydraulic line fitting, allowing the air to escape. Close the fitting and have the pedal released.
5. Repeat Steps 3 and 4 for each fitting until all the air is released.

Wheel Speed Sensor

REMOVAL AND INSTALLATION

Rear Anti-lock Brake System (RABS)

Rear Axle Sensor

1. Disconnect the negative battery cable.
2. Detach the wiring harness connector from the anti-lock sensor.
3. Remove the sensor hold-down bolt and remove the sensor from the axle housing.

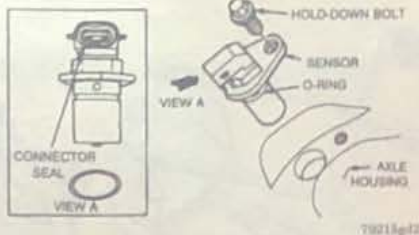
To install:

4. Clean the axle mounting surface. Use care to prevent dirt from entering the axle housing.
5. Inspect and clean the magnetized sensor pole piece to ensure that it is free from loose metal particles which could cause erratic system operation. Inspect the sensor O-ring for damage and replace, if necessary.
6. Lightly lubricate the sensor O-ring with motor oil, align the sensor bolt hole and install. Do not apply force to the plastic sensor connector. The sensor flange should slide to the mounting surface. This will insure the air gap setting is between 0.005-0.045 in. (0.127-1.14mm).
7. Install the hold down bolt and tighten to 25-30 ft. lbs. (34-40 Nm).
8. Inspect the blue sensor connector seal and replace if missing or damaged. Push the connector on the sensor.
9. Connect the negative battery cable.

4-Wheel Anti-lock Brake System

Front Wheel Speed Sensor

1. Inside the engine compartment, disconnect the sensor from the harness.
2. Unclip the sensor cable from the brake hose clips.
3. Remove the retaining bolt from the spindle and slide the sensor from its hole.



RABS sensor installation

4. Installation is the reverse of the removal. Torque the retaining bolt to 40-60 inch lbs. (4.5-6.7 Nm)

Rear Speed Sensor

1. Disconnect the wiring from the harness.
2. Remove the sensor hold-down bolt and remove the sensor from the axle.

To install:

3. Thoroughly clean the mounting surfaces. Make sure no dirt falls into the axle. Clean the magnetized sensor pole piece. Metal particles can cause sensor problems. Replace the O-ring.
4. Coat the new O-ring with clean engine oil.
5. Position the new sensor on the axle. It should slide into place easily. Correct installation will allow a gap of 0.005-0.045 in. (0.127-1.143mm).
6. Tighten the hold-down bolt to 25-30 ft. lbs. (34-40 Nm).
7. Connect the wiring.

FRONT SUSPENSION

Shock Absorbers

REMOVAL AND INSTALLATION

F-150 and Bronco Models

Except 4WD Models With Quad Shocks, and 1997 F-150 and Expedition Models

1. Remove the upper nut while holding the shock absorber stem.
2. Remove the lower mounting bolt/nut from the bracket.
3. Compress the shock and remove it.
4. Installation is the reverse of removal. Hold the stud while tightening the upper nut to 30 ft. lbs. (41

Nm). Torque the lower bolt/nut to 60 ft. lbs. (81 Nm).

4WD Models with Quad Shocks

1. Remove the upper nut while holding the shock absorber stem on both forward and rearward shocks.
2. Remove the lower mounting bolt/nut from the rearward shock bracket; the nut and washer from the forward shock bracket.
3. Compress the shocks and remove them.
4. Cut the insulators from the upper spring seat.
5. Install new one piece insulators into the top surface of the upper spring seat. Coat them with a soap solution to aid in installation.
6. Installation of the shocks is the reverse of removal. Use a new steel washer under the upper nut. Hold the stud while tightening the upper nut to 30 ft. lbs. (41 Nm). Torque the lower bolt/nut to 60 ft. lbs. (81 Nm).

1997 F-150 and Expedition Models With 2-Wheel Drive

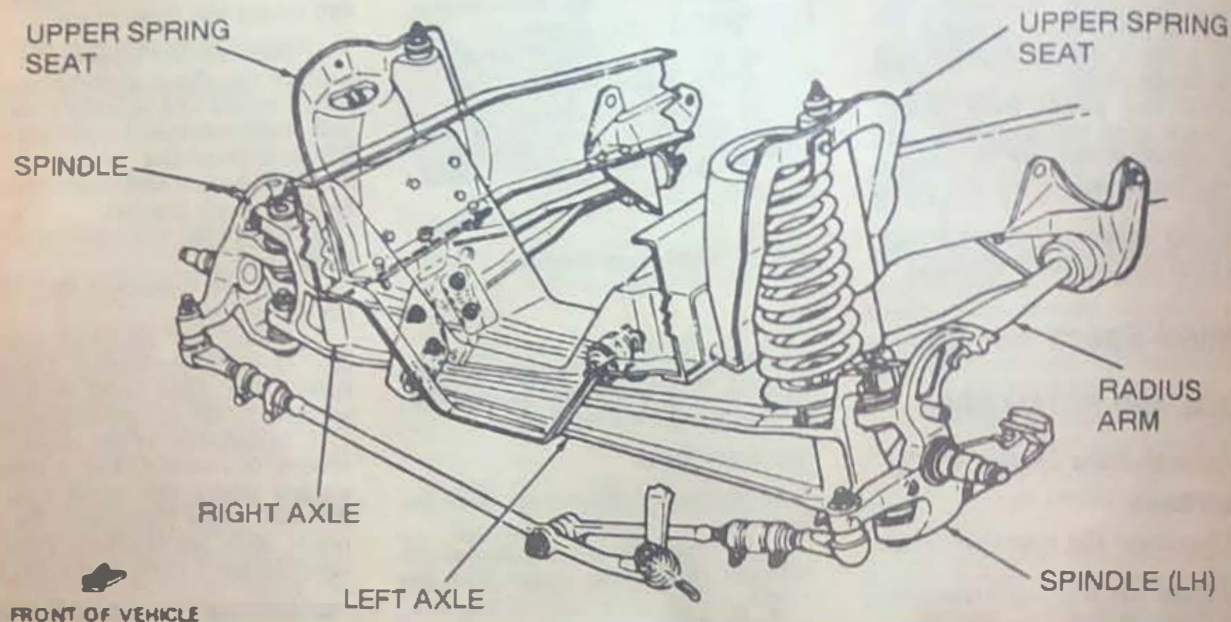
1. Remove the upper shock absorber nut and washer by holding the shock stem from rotating while loosening the nut and washer.
2. Raise and support the front of the vehicle safely on jackstands.
3. On 2-wheel drive models, remove the 2 lower shock absorber mounting nuts, then lower the shock from inside of the coil spring.
4. On 4-wheel drive models, remove the lower shock absorber mounting bolt and nut. Remove the shock absorber from the vehicle.

To install:

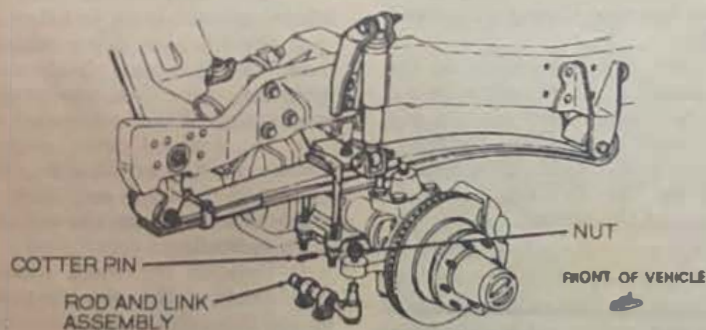
5. Position the shock absorber in the vehicle so that the top post is inserted through the top mounting hole of the vehicle's upper spring pad.
6. On 4-wheel drive models, install the lower mounting bolt and nut to 56-76 ft. lbs. (76-103 Nm).
7. On 2-wheel drive models, install the 2 lower shock absorber mounting bolts and tighten to 19-25 ft. lbs. (26-34 Nm).
8. Install the upper shock absorber nut and washer. While holding the shock stem, tighten the nut to 34-46 ft. lbs. (47-63 Nm) for 2WD models, and to 57-77 ft. lbs. (77-104 Nm).
9. Lower the vehicle.

F-250 and F-350 Models

1. Remove the nut/bolt retaining the shock to the upper bracket.
2. Remove the lower mounting bolt/nut from the bracket.



Front suspension assembly—2WD 1993-96 F Series models



Front suspension assembly—F-350 models

Coil Springs

REMOVAL AND INSTALLATION

Except 1997 F-150 and Expedition Models

1. Raise the front of the vehicle and place jackstands under the frame and a jack under the axle.

2. Remove the wheels.
3. Disconnect the shock absorber from the lower bracket.
4. Remove one bolt and nut and remove the rebound bracket.
5. Remove the two spring upper retainer attaching bolts from the top of the spring upper seat and remove the retainer.
6. Remove the nut attaching the spring lower retainer to the lower seat and axle and remove the retainer.
7. Place a safety chain through the spring to prevent it from suddenly coming loose. Slowly lower the axle and remove the spring.

To install:

8. Place the spring in position and raise the front axle.
9. Position the spring lower retainer over the stud and lower seat, and install the two attaching bolts.
10. Position the upper retainer over the spring coil and against the spring upper seat, and install the two attaching bolts.
11. Tighten the upper retaining bolts to 13-18 ft. lbs. (18-25 Nm), the lower retainer attaching nuts to 70-100 ft. lbs. (95-135 Nm).
12. Connect the shock absorber to the lower bracket. Torque the bolt and nut to 40-60 ft. lbs. (54-81 Nm). Install the rebound bracket.
13. Remove the jack and safety stands.

1997 F-150 and Expedition Models

1. Raise and support the front of the vehicle safely on jack stands.
2. Remove the wheels.
3. Remove the disc brake rotor splash shield.
4. Remove the shock absorber.
5. Remove the brake hose bracket from the front suspension lower control arm.
6. Remove the front stabilizer bar end-link nut.

7. Use Coil Spring Compressor D78P-5310-A, or its equivalent, to compress the coil spring.

8. Remove the lower ball joint cotter pin and castle nut.

9. Use a Pitman arm puller, such as Ford Tool T64P-3590-F, to separate the lower ball joint stud from the front wheel spindle.

10. Matchmark the position of the lower control arm left-hand cam (offset washer under the control arm-to-frame bolt).

11. Remove the 2 control arm lower nuts, then remove the lower bolts.

12. Remove the control arm and coil spring from the vehicle.

To install:

NOTE: The end of the coil spring must cover the first hole and be visible in the second hole — the holes are located in the coil spring mounting groove of the lower control arm.

13. Install the front coil spring, already compressed, into the lower control arm.

NOTE: The lower control arm forward nut must first be tightened while the control arms are held at the curb position ride height. Also, when installing the left-hand control arm bolt, align the matchmarks of the bolt cam.

14. Position the lower control arm and coil spring in the vehicle, then install the control arm-to-frame bolts and nuts. Hold the lower control arm at ride height, then tighten the nuts and bolts to 197–241 ft. lbs. (270–330 Nm). Make sure that the matchmarks are correctly aligned.

15. Insert the lower ball joint stud, along with the ball joint shield, into the steering knuckle, then install the castle nut. Tighten the castle nut to 83–113 ft. lbs. (113–153 Nm). Install a new cotter pin. If the cotter pin hole and castle nut grooves are not aligned, tighten, never loosen, the nut until they are aligned.

16. Install and tighten the stabilizer bar end-link nut to 15–21 ft. lbs. (21–29 Nm).

17. Slowly remove the coil spring compressor, while making sure that the spring is correctly seated in the lower control arm and the upper spring pad.

18. Install the shock absorber.

19. Install the disc brake rotor splash shield and the front wheels, then lower the vehicle.

20. Have the front end alignment inspected.

Leaf Springs

REMOVAL AND INSTALLATION

2-Wheel Drive Models

1. Raise and support the front end on jackstands with the tires still touching the ground.

2. Using jacks, take up the weight of the axle, off the U-bolts.

3. Disconnect the lower end of each shock absorber.

4. Disconnect the spring from the front bracket or shackle.

5. Disconnect the spring from the rear bracket or shackle.

6. Remove the U-bolt nuts.

7. Remove the U-bolts.

8. Disconnect the jack bracket or stabilizer bar as necessary.

9. Lower the axle slightly and remove the spring. Take note of the position of the spring spacer.

To install

10. Position the spring on its seat on the axle and raise it to align the front of the spring with the bracket or shackle.

11. Coat the bushing with silicone grease.

12. Carefully guide the attaching bolt through the bracket or shackle, and the bushing.

13. Install the nut and torque it to:

- chassis/cab spring-to-shackle — 120–150 ft. lbs. (163–203 Nm)

- chassis/cab shackle-to-frame — 150–210 ft. lbs. (203–286 Nm)

- stripped chassis or motor home chassis spring-to-bracket — 148–207 ft. lbs. (201–282 Nm)

14. In a similar fashion, attach the rear of the spring. The torques are:

- chassis/cab spring-to-bracket — 150–210 ft. lbs. (203–286 Nm)

- stripped chassis or motor home chassis spring-to-shackle or shackle-to-bracket — 74–110 ft. lbs. (101–150 Nm)

15. Position the spacer on the spring.

16. Install the U-bolts. Install the jack bracket or stabilizer bar bracket on the forward U-bolt. Install the U-bolt nuts. Torque the nuts, evenly and in gradual increments, in a criss-cross fashion, to:

- chassis/cab — 150–210 ft. lbs. (203–286 Nm)

- stripped chassis and motor home chassis — 220–300 ft. lbs. (299–408 Nm)

17. Connect the shock absorbers. Torque them to:

- chassis/cab models, shock absorber-to-bracket nuts to 52–74 ft. lbs. (71–101 Nm)

- stripped chassis or motor home chassis models, lower attaching bolt to 220–300 ft. lbs. (299–408 Nm)

4-Wheel Drive Models

1. Raise the vehicle frame until the weight is off the front spring with the wheels still touching the floor. Support the axle to prevent rotation.

2. Disconnect the lower end of the shock absorber from the U-bolt spacer. Remove the U-bolts, U-bolt cap and spacer. On F-350 models, remove the 2 bolts retaining the track bar to the spring cap and the track bar bracket.

3. Remove the nut from the hanger bolt retaining the spring at the rear and drive out the hanger bolt.

4. Remove the nut connecting the front shackle and spring eye and drive out the shackle bolt and remove the spring.

To install:

5. Position the spring on the spring seat. Install the shackle bolt through the shackle and spring. Torque the nuts to 150 ft. lbs.

6. Position the rear of the spring and install the hanger bolt. Torque the nut to 150 ft. lbs. (203 Nm).

7. Position the U-bolt spacer and place the U-bolts in position through the holes in the spring seat cap. Install but do not tighten the U-bolt nut. On the F-350, install the track bar. Torque the track bar-to-bracket bolts to 200 ft. lbs. (272 Nm).

8. Connect the lower end of the shock absorber to the U-bolt spacer. Torque the fasteners to 60 ft. lbs. (81 Nm) on the F-250; 70 ft. lbs. (95 Nm) on the F-350.

9. Lower the vehicle and tighten the U-bolt nuts to 120 ft. lbs. (163 Nm).

Torsion Bar

REMOVAL AND INSTALLATION

1997 F-150 and Expedition Models

1. Raise and support the front of the vehicle safely on jackstands.

2. Make an alignment mark on the torsion bar and the torsion bar cross-member support.

3. Measure and record the length from the torsion bar adjuster bolt head to the adjuster bracket.

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4. Relieve the torsion bar tension as follows:

- Install the Torsion Bar Tool T95T-5310-A with the Adapter Plates T96T-5310-A, or their equivalents, onto the frame rail with the tool shaft pointing toward the torsion bar adjuster.
 - Tighten the tool until it touches the torsion bar adjuster.
 - Remove the torsion bar adjuster bolt and nut.
 - Slowly remove the torsion bar tool, then remove the torsion bar adjuster.
 - Repeat Steps 4a through 4d for the other side of the vehicle.
5. Remove the 6 torsion bar cross-member support bolts.
6. Remove the torsion bar cross-member support, then remove the torsion bars from the vehicle.

To install:

- Position the torsion bars in the lower control arms, then install the torsion bar crossmember support. Tighten the 6 support bolts; the center bolts on each side should be tightened to 30-40 ft. lbs. (40-55 Nm), whereas the outer 4 bolts and accompanying nuts should be tightened to 39-53 ft. lbs. (53-72 Nm).
- Install the torsion bar adjuster, then install the torsion bar tool and adapter plates.
- Tighten the torsion bar tool to load the torsion bar.
- Install the torsion bar adjuster nut and bolt.
- Remove the torsion bar tool.
- Turn the torsion bar adjuster until the reference marks align, then repeat the procedure for the other side of the vehicle.
- Install the front brake anti-lock sensor wire bracket bolt, if applicable.
- Have the front end alignment and the ride height checked.

Upper and Lower Ball Joints

REMOVAL AND INSTALLATION

Except F-150, Bronco and Expedition Models

- Raise and support the vehicle safely.
- Remove the spindles and left and right shafts and joint.
- Remove the tie rod nut and disconnect the tie rod from the steering arm.
- Remove the cotter pin from the top ball joint stud. Remove the nut

from the top stud and loosen the nut on the lower stud inside the knuckle.

5. Hit the top stud sharply with a plastic mallet to free the knuckle from the axle arm. Remove and discard the bottom nut. New nuts should be used at assembly.

6. Note the positioning of the camber adjuster carefully for reassembly. Remove the camber adjuster. If it's hard to remove, use a puller.

7. Place the knuckle in a vise and remove the snapping from the bottom ball joint. Not all ball joints will have this snapping.

8. Remove the plug from C-frame tool T74P-4635-C and replace it with plug T80T-3010-A. Assemble C-frame tool T74P-4635-C and receiving cup D79T-3010-G (Bronco, F-150 and 250) or T80T-3010-A2 (F-250 Heavy Duty and F-350) on the knuckle.

9. Turn the forcing screw inward until the ball joint is separated from the knuckle.

10. Assemble the C-frame tool with receiving cup D79P-3010-BG on the upper ball joint and force it out of the knuckle.

NOTE: Always force out the bottom ball joint first.

11. Clean the ball joint bores thoroughly.

12. Insert the lower joint into its bore as straight as possible.

13. On the Bronco, F-150 and F-250, assemble the C-frame tool, receiving cup T80T-3010-A3 and installing cup D79T-3010-BF onto the lower ball joint. On the F-250 Heavy Duty and F-350, assemble the C-frame tool, receiving cup T80T-3010-A3 and receiving cup D79T-3010-BG on the lower ball joint.

14. Turn the screw clockwise until the ball joint is firmly seated.

NOTE: If the ball joint cannot be installed to the correct depth, realign the receiving cup on the tool.

15. On all models, assemble the C-frame, receiving cup T80T-3010-A3 and replacer T80T-3010-A1 on the upper ball joint.

16. Turn the screw clockwise until the ball joint is firmly seated.

17. Place the knuckle into position on the axle arm. Install the camber adjuster on the upper ball joint stud with the arrow point to positive or negative as noted before disassembly.

18. Install a new nut on the bottom stud, finger tight. Install a new nut on the top stud finger tight.

19. Tighten the bottom nut to 80 ft. lbs. (109 Nm).

20. Tighten the top nut to 100 ft. lbs. (136 Nm), then, (tighten) advance the nut until the cotter pin hole align with the castellations. Install a new cotter pin.

21. Again tighten the bottom nut, this time to 110 ft. lbs. (149 Nm).

22. Install all other parts.

F-150, Bronco and Expedition Models

1993-96 Vehicles

- Remove the spindle.
- Remove the snapping from the ball joints. Assemble the C-frame assembly T74P-4635-C and receiver cup D81T-3010-A, or equivalents, on the upper ball joint. Turn the forcing screw clockwise until the ball joint is removed from the axle.
- Repeat Step 2 on the lower ball joint.

NOTE: The upper ball joint must always be removed first. DO NOT heat the ball joint or spindle!

To install:

NOTE: The lower ball joint must be installed first.

4. To install the lower ball joint, assemble the C-frame with ball joint receiver cup D81T-3010-A5 and installation cup D81T-3010-A1, and turn the forcing screw clockwise until the ball joint is seated. **DO NOT heat the ball joint to aid in installation!**

5. Install the snapping onto the ball joint.

6. Install the upper ball joint in the same manner as the lower ball joint.

7. Install the spindle assembly.

1997 Vehicles

The upper and lower ball joints on the 1997 F-150 and Expedition models are integral to the control arms. If the ball joints are deemed faulty, the control arm and ball joint must be replaced as an assembly.

INSPECTION

1. Before an inspection of the ball joints, make sure the front wheel bearings are properly packed and adjusted.

2. Jack up the front of the vehicle and safely support it with jackstands, placing the stands under the I-beam axle beneath the spring as shown in the accompanying illustration.

3. Have a helper grab the lower edge of the tire and move the wheel assembly in and out.

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4. Relieve the torsion bar tension as follows:

- Install the Torsion Bar Tool T95T-5310-A with the Adapter Plates T96T-5310-A, or their equivalents, onto the frame rail with the tool shaft pointing toward the torsion bar adjuster.
 - Tighten the tool until it touches the torsion bar adjuster.
 - Remove the torsion bar adjuster bolt and nut.
 - Slowly remove the torsion bar tool, then remove the torsion bar adjuster.
 - Repeat Steps 4a through 4d for the other side of the vehicle.
5. Remove the 6 torsion bar cross-member support bolts.
6. Remove the torsion bar cross-member support, then remove the torsion bars from the vehicle.

To install:

- Position the torsion bars in the lower control arms, then install the torsion bar crossmember support. Tighten the 6 support bolts; the center bolts on each side should be tightened to 30-40 ft. lbs. (40-55 Nm), whereas the outer 4 bolts and accompanying nuts should be tightened to 39-53 ft. lbs. (53-72 Nm).
- Install the torsion bar adjuster, then install the torsion bar tool and adapter plates.
- Tighten the torsion bar tool to load the torsion bar.
- Install the torsion bar adjuster nut and bolt.
- Remove the torsion bar tool.
- Turn the torsion bar adjuster until the reference marks align, then repeat the procedure for the other side of the vehicle.
- Install the front brake anti-lock sensor wire bracket bolt, if applicable.
- Have the front end alignment and the ride height checked.

Upper and Lower Ball Joints

REMOVAL AND INSTALLATION

Except F-150, Bronco and Expedition Models

- Raise and support the vehicle safely.
- Remove the spindles and left and right shafts and joint.
- Remove the tie rod nut and disconnect the tie rod from the steering arm.
- Remove the cotter pin from the top ball joint stud. Remove the nut

from the top stud and loosen the nut on the lower stud inside the knuckle.

5. Hit the top stud sharply with a plastic mallet to free the knuckle from the axle arm. Remove and discard the bottom nut. New nuts should be used at assembly.

6. Note the positioning of the camber adjuster carefully for reassembly. Remove the camber adjuster. If it's hard to remove, use a puller.

7. Place the knuckle in a vise and remove the snapping from the bottom ball joint. Not all ball joints will have this snapping.

8. Remove the plug from C-frame tool T74P-4635-C and replace it with plug T80T-3010-A. Assemble C-frame tool T74P-4635-C and receiving cup D79T-3010-G (Bronco, F-150 and 250) or T80T-3010-A2 (F-250 Heavy Duty and F-350) on the knuckle.

9. Turn the forcing screw inward until the ball joint is separated from the knuckle.

10. Assemble the C-frame tool with receiving cup D79P-3010-BG on the upper ball joint and force it out of the knuckle.

NOTE: Always force out the bottom ball joint first.

11. Clean the ball joint bores thoroughly.

12. Insert the lower joint into its bore as straight as possible.

13. On the Bronco, F-150 and F-250, assemble the C-frame tool, receiving cup T80T-3010-A3 and installing cup D79T-3010-BF onto the lower ball joint. On the F-250 Heavy Duty and F-350, assemble the C-frame tool, receiving cup T80T-3010-A3 and receiving cup D79T-3010-BG on the lower ball joint.

14. Turn the screw clockwise until the ball joint is firmly seated.

NOTE: If the ball joint cannot be installed to the correct depth, realign the receiving cup on the tool.

15. On all models, assemble the C-frame, receiving cup T80T-3010-A3 and replacer T80T-3010-A1 on the upper ball joint.

16. Turn the screw clockwise until the ball joint is firmly seated.

17. Place the knuckle into position on the axle arm. Install the camber adjuster on the upper ball joint stud with the arrow point to positive or negative as noted before disassembly.

18. Install a new nut on the bottom stud, finger tight. Install a new nut on the top stud finger tight.

19. Tighten the bottom nut to 80 ft. lbs. (109 Nm).

20. Tighten the top nut to 100 ft. lbs. (136 Nm), then, (tighten) advance the nut until the cotter pin hole align with the castellations. Install a new cotter pin.

21. Again tighten the bottom nut, this time to 110 ft. lbs. (149 Nm).

22. Install all other parts.

F-150, Bronco and Expedition Models

1993-96 Vehicles

- Remove the spindle.
- Remove the snapping from the ball joints. Assemble the C-frame assembly T74P-4635-C and receiver cup D81T-3010-A, or equivalents, on the upper ball joint. Turn the forcing screw clockwise until the ball joint is removed from the axle.
- Repeat Step 2 on the lower ball joint.

NOTE: The upper ball joint must always be removed first. DO NOT heat the ball joint or spindle!

To install:

NOTE: The lower ball joint must be installed first.

4. To install the lower ball joint, assemble the C-frame with ball joint receiver cup D81T-3010-A5 and installation cup D81T-3010-A1, and turn the forcing screw clockwise until the ball joint is seated. **DO NOT heat the ball joint to aid in installation!**

5. Install the snapping onto the ball joint.

6. Install the upper ball joint in the same manner as the lower ball joint.

7. Install the spindle assembly.

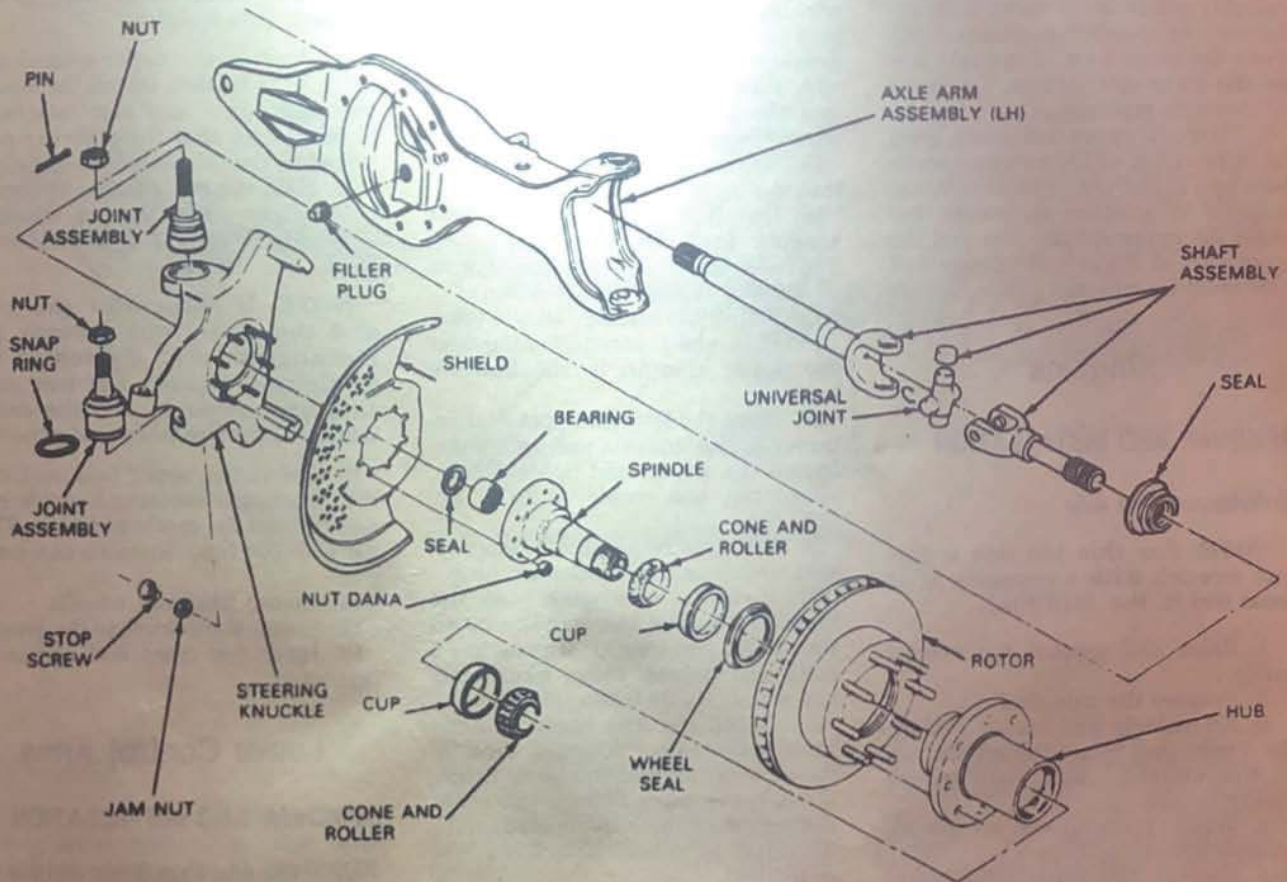
1997 Vehicles

The upper and lower ball joints on the 1997 F-150 and Expedition models are integral to the control arms. If the ball joints are deemed faulty, the control arm and ball joint must be replaced as an assembly.

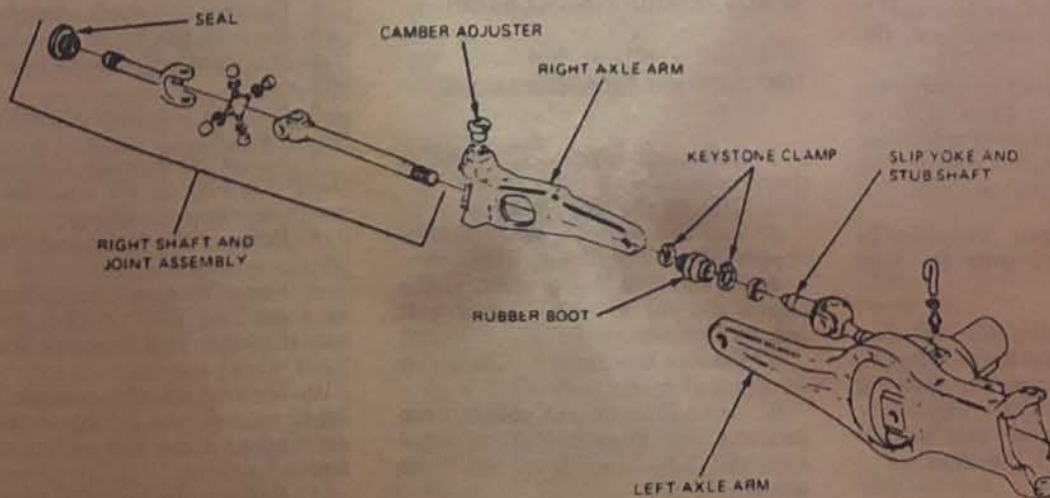
INSPECTION

- Before an inspection of the ball joints, make sure the front wheel bearings are properly packed and adjusted.
- Jack up the front of the vehicle and safely support it with jackstands, placing the stands under the I-beam axle beneath the spring as shown in the accompanying illustration.
- Have a helper grab the lower edge of the tire and move the wheel assembly in and out.

Spindle and Left Shaft and Joint Installation—Typical



Right Hand Shaft and Joint Assembly Installation—Typical



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Dana models 44 and 50 axle shaft and joint assemblies — Bronco, F Series (Pick-Up) and E Series (Van)

4. While the wheel is being moved, observe the lower spindle arm and the lower part of the axle jaw (the end of the axle to which the spindle assembly attaches). If there is $\frac{1}{32}$ in. (0.8mm) or greater movement between the lower part of the axle jaw and the lower spindle arm, the lower ball must be replaced.

5. To check upper ball joints, grab the upper edge of the tire and move the wheel in and out. If there is $\frac{1}{32}$ in. (0.8mm) or greater movement between the upper spindle arm and the upper part of the jaw, the upper ball joint must be replaced.

Kingpins

REMOVAL AND INSTALLATION

Monobeam Front Axle

NOTE: For this job use a torque wrench with a capacity of at least 600 ft. lbs. (816 Nm).

1. Raise and support the vehicle safely.

2. Remove the axle shafts.

3. Alternately and evenly remove the 4 bolts that retain the spindle cap to the knuckle. This will relieve spring tension.

4. When spring tension is relieved, remove the bolts.

5. Remove the spindle cap, compression spring and retainer. Discard the gasket.

6. Remove the 4 bolts securing the lower kingpin and retainer to the knuckle. Remove the lower kingpin and retainer.

7. Remove the tapered bushing from the top of the upper kingpin.

8. Remove the knuckle from the axle yoke.

9. Remove the upper kingpin from the axle yoke with a piece of $\frac{1}{2}$ in. hex-shaped case hardened metal bar stock, or, with a $\frac{1}{2}$ in. hex socket. Discard the upper kingpin and seal.

NOTE: The upper kingpin is tightened to 500-600 ft. lbs. (680-816 Nm).

10. Using a 2-jawed puller and step plate, press out the lower kingpin grease retainer, bearing cup, bearing and seal from the axle yoke lower bore. Discard the grease seal and retainer, and the lower bearing cup.

To install:

11. Coat the mating surfaces of a new lower kingpin grease retainer with RTV silicone sealer.

12. Install the retainer in the axle yoke bore so the concave portion of the retainer faces the upper kingpin.

13. Using a bearing driver, drive a new bearing cup in the lower kingpin bore until it bottoms against the grease retainer.

14. Pack the lower kingpin bearing and the yoke bore with waterproof wheel bearing grease.

15. Using a driver, drive a new seal into the lower kingpin bore.

16. Install a new seal and upper kingpin into the yoke using tool T86T-3110-AH. Tighten the kingpin to 500-600 ft. lbs. (680-816 Nm).

17. Install the knuckle on the yoke.

18. Place the tapered bushing over the upper kingpin in the knuckle bore.

19. Place the lower kingpin and retainer in the knuckle and axle yoke. Install the 4 bolts and tighten them, alternately and evenly, to 90 ft. lbs. (122 Nm).

20. Place the retainer and compression spring on the tapered bushing.

21. Install a new gasket on the knuckle. Position the spindle cap on the gasket and knuckle. Install the 4 bolts and tighten them, alternately and evenly, to 90 ft. lbs. (122 Nm).

22. Install the axle shafts and lubricate the upper kingpin through the zerk fitting and the lower fitting through the flush fitting. The lower fitting may be lubricated with Alemite adapter No. 6783, or equivalent.

Upper Control Arms

REMOVAL AND INSTALLATION

1997 F-150 and Expedition Models

1. Raise and support the front of the vehicle safely on jackstands.

2. Remove the front wheels.

3. Use a hydraulic floor jack to support the lower control arm.

4. Matchmark the position of the upper control arm mounting bolt cams (offset washers).

5. Remove the upper ball joint cotter pin and castle nut.

6. Use a Pitman arm puller, such as Ford Tool T64P-3590-F, to separate the ball joint from the front wheel spindle.

7. Remove the upper control arm mounting nuts and bolts, then remove the arm from the vehicle.

To install:

NOTE: The forward upper control arm mounting nut must be tightened first while held at the normal ride height.

8. Position the upper control arm in the vehicle, then install the mounting bolts, nuts and cam (washers). Make certain that the cams are positioned so that the matchmarks align.

9. Hold the control arm at normal ride height, then tighten the nuts and bolts to 84-112 ft. lbs. (113-153 Nm).

NOTE: If the cotter pin hole and the castle nut grooves are not aligned after tightening the castle nut, tighten the nut until they are; never loosen the castle nut to align the hole and grooves.

10. Insert the upper ball joint stud into the upper steering knuckle hole and tighten the castle nut to 56-77 ft. lbs. (76-104 Nm). Install a new cotter pin.

11. Install the front wheels.

12. Lower the vehicle to the ground.

13. Have the front end alignment inspected.

Lower Control Arms

REMOVAL AND INSTALLATION

1997 F-150 and Expedition Models

2-Wheel Drive

1. Raise and support the front of the vehicle safely on jackstands.

2. Remove the wheels.

3. Remove the disc brake rotor splash shield.

4. Remove the shock absorber.

5. Remove the brake hose bracket from the front suspension lower control arm.

6. Remove the front stabilizer bar end-link nut.

7. Use Coil Spring Compressor D78P-5310-A, or its equivalent, to compress the coil spring.

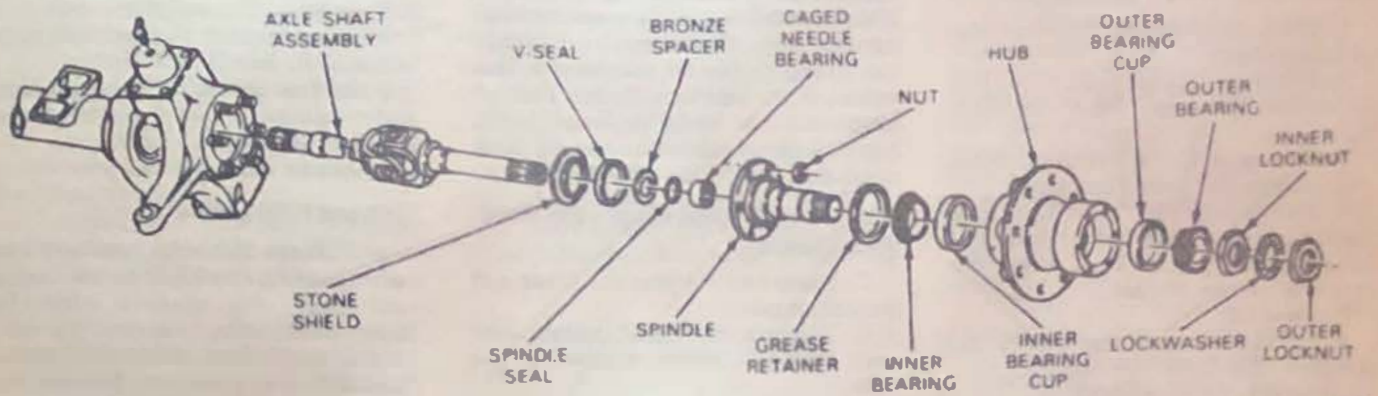
8. Remove the lower ball joint cotter pin and castle nut.

9. Use a Pitman arm puller, such as Ford Tool T64P-3590-F, to separate the lower ball joint stud from the front wheel spindle.

10. Matchmark the position of the lower control arm left-hand cam (offset washer under the control arm-to-frame bolt).

11. Remove the 2 control arm lower nuts, then remove the lower bolts.

12. Remove the control arm and coil spring from the vehicle.



Dana model 50 Monobeam front drive axle assembly

To install:

NOTE: The end of the coil spring must cover the first hole and be visible in the second hole—the holes are located in the coil spring mounting groove of the lower control arm.

13. Install the front coil spring, already compressed, into the lower control arm.

NOTE: The lower control arm forward nut must first be tightened while the control arms are held at the curb position ride height. Also, when installing the left-hand control arm bolt, align the matchmarks of the boltcam.

14. Position the lower control arm and coil spring in the vehicle, then install the control arm-to-frame bolts and nuts. Hold the lower control arm at ride height, then tighten the nuts and bolts to 197–241 ft. lbs. (270–330 Nm). Make sure that the matchmarks are correctly aligned.

15. Insert the lower ball joint stud, along with the ball joint shield, into the steering knuckle, then install the castle nut. Tighten the castle nut to 83–113 ft. lbs. (113–153 Nm). Install a new cotter pin. If the cotter pin hole and castle nut grooves are not al-

igned, tighten, never loosen, the nut until they are aligned.

16. Install and tighten the stabilizer bar end-link nut to 15–21 ft. lbs. (21–29 Nm).

17. Slowly remove the coil spring compressor, while making sure that the spring is correctly seated in the lower control arm and the upper spring pad.

18. Install the shock absorber.

19. Install the disc brake rotor splash shield and the front wheels, then lower the vehicle.

20. Have the front end alignment inspected.

4-Wheel Drive

1. Raise and safely support the front of the vehicle on jackstands.

2. Remove the front wheel hub.

3. Remove the torsion bars.

4. Use strong wire or cord to suspend the upper control arm from the vehicle body or frame.

5. If necessary, suspend the half-shaft with wire or cord also.

6. Remove the stabilizer bar link nut from the front suspension lower arm.

7. Remove the shock absorber lower bolt and nut from the control arm.

8. Remove the lower ball joint cotter pin and castle nut, then separate the lower ball joint from the steering knuckle using a Pitman arm puller, such as Ford Tool T64P-3590-F.

9. Remove the 2 lower control arm nuts and bolts, then remove the control arm from the vehicle's frame.

To install:

10. Install the lower control arm to the vehicle's frame, then install the mounting bolts and nuts. Tighten the lower control arm bolts and nuts to 121–148 ft. lbs. (164–200 Nm).

11. Install the front stabilizer bar link to the control arm. Tighten the nut to 16–21 ft. lbs. (22–28 Nm).

12. Install the shock absorber lower bolt and nut to 56–76 ft. lbs. (76–103 Nm).

13. Install the lower ball joint stud into the lower steering arm hole, then tighten the castle nut to 83–208 (113–153 Nm). Then install a new cotter pin.

14. Install the torsion bars.

15. Install the wheel hub and bearing unit.

16. Install the front wheels and lower the vehicle.

17. Have the front end alignment and ride height inspected.

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Stabilizer Bar

REMOVAL AND INSTALLATION

2-Wheel Drive Models

1993-96 Except F-Super Duty Models

1. Raise and support the front end on jackstands.
2. Disconnect the right and left stabilizer bar ends from the link assembly.
3. Disconnect the retainer bolts and remove the stabilizer bar.
4. Disconnect the stabilizer link assemblies by loosening the right and left locknuts from their respective brackets on the I-beams.

To install:

5. Loosely install the entire assembly. The links are marked with an R and L for identification.
6. Tighten the link-to-stabilizer bar and axle bracket fasteners to 70 ft. lbs. (95 Nm).
7. Check to make sure the insulators are properly seated and the stabilizer bar is centered.
8. Tighten the stabilizer bar to crossmember attaching bolts to 35 ft. lbs. (48 Nm). On the F-250, F-350, E-250 and E-350 models, tighten the stabilizer bar-to-frame retainer bolts to 35 ft. lbs. (48 Nm). Torque the frame mounting bracket nuts/bolts to 65 ft. lbs. (88 Nm).

1997 F-150 and Expedition Models

1. Raise and safely support the front of the vehicle on jackstands.
2. Remove the stabilizer bar nut from the lower control arms.
3. Remove the left-hand and right-hand stabilizer bar links.
4. Remove the stabilizer bar retaining bolts, then lower the bar off of the front frame rails.
5. Remove the stabilizer bar insulators.

To install:

6. Install the stabilizer bar insulators and position the stabilizer bar onto the frame rails. Tighten the 4 mounting bolts to 19-26 ft. lbs. (26-35 Nm).
7. Install the stabilizer bar end links, then tighten the end link nuts to 12-15 ft. lbs. (15-20 Nm).
8. Lower the vehicle.

F-Super Duty Chassis and Cab Models

1. Raise and support the front end on jackstands.
2. Disconnect each end of the bar from the links.
3. Disconnect the bar from the axle.

4. Unbolt and remove the links from the frame.

5. Installation is the reverse of removal. Replace any worn or cracked rubber parts. Install the bar loosely and make sure it is centered between the leaf springs. Make sure the insulators are seated in the retainers. When everything is in proper order, tighten the stabilizer bar-to-axle mounting bolts to 35-50 ft. lbs. (48-61 Nm). Tighten the end link-to-frame bolts to 52-74 ft. lbs. (71-101 Nm). Tighten the bar-to-end link nuts to 15-25 ft. lbs. (20-34 Nm).

F-Super Duty Stripped Chassis and Motor Home Chassis

1. Raise and support the front end on jackstands.
2. Disconnect the stabilizer bar ends from the links attached to the axle.
3. Remove the bar-to-frame bolts and remove the bar.
4. Remove the links from the axle brackets.
5. Installation is the reverse of removal. Replace any worn or cracked rubber parts. Assemble all parts loosely and make sure the assembly is centered on the frame. Make sure the insulators are seated in the retainers. When everything is in proper order, tighten the bar-to-frame brackets bolts to 30-47 ft. lbs. (41-64 Nm). Tighten the link-to-axle bracket bolts to 57-81 ft. lbs. (78-110 Nm). Tighten the bar-to-link nuts to 15-25 ft. lbs. (20-34 Nm).

4-Wheel Drive Models

1993-96 F-150 and Bronco

1. Unbolt the stabilizer bar from the connecting links.
2. Unbolt the stabilizer bar retainers.
3. If necessary to remove the stabilizer bar mounting bracket, remove the coil springs as described above.
4. Installation is the reverse of removal. Torque the retainer nuts to 35 ft. lbs. (48 Nm), then torque all other nuts at the links to 70 ft. lbs. (95 Nm).

1997 F-150 and Expedition Models

1. Raise and safely support the front of the vehicle on jackstands.
2. Remove the undercarriage skid plate.
3. Remove the stabilizer bar nut from the lower control arms.
4. Remove the left-hand and right-hand stabilizer bar links.
5. Remove the stabilizer bar retaining bolts, then lower the bar off of the front frame rails.

6. Remove the stabilizer bar insulators.

To install:

7. Install the stabilizer bar insulators and position the stabilizer bar onto the frame rails. Tighten the 4 mounting bolts to 19-26 ft. lbs. (26-35 Nm).
8. Install the stabilizer bar end links, then tighten the end link nuts to 12-15 ft. lbs. (15-20 Nm).
9. Install the undercarriage skid plate; tighten the skid plate bolts to 10-13 ft. lbs. (14-17 Nm).
10. Lower the vehicle.

F-250 and F-350 Models

1. Remove the bolts, washers and nuts securing the links to the spring seat caps. On models with the Monobeam axle, remove the nut, washer and bolt securing the links to the mounting brackets. Remove the nuts, washers and insulators connecting the links to the stabilizer bar. Remove the links.
2. Unbolt and remove the retainers from the mounting brackets.
3. Remove the stabilizer bar.
4. Installation is the reverse of removal. Torque the connecting links-to-spring seat caps to 70 ft. lbs. (95 Nm). Torque the nuts securing the connecting links to the stabilizer bar to 25 ft. lbs. (34 Nm). Torque the retainer-to-mounting bracket nuts to 35 ft. lbs. (48 Nm).

Radius Arm

REMOVAL AND INSTALLATION

2-Wheel Drive Models

NOTE: A torque wrench with a capacity of at least 350 ft. lbs. (476 Nm) is necessary, along with other special tools, for this procedure.

1. Raise the front of the vehicle and place safety stands under the frame and a jack under the wheel or axle. Remove the wheels.
2. Disconnect the shock absorber from the radius arm bracket.
3. Remove the two spring upper retainer attaching bolts from the top of the spring upper seat and remove the retainer.
4. Remove the nut which attached the spring lower retainer to the lower seat and axle and remove the retainer.
5. Lower the axle and remove the spring.
6. Remove the spring lower seat and ahim from the radius arm. The

remove the bolt and nut which attach the radius arm to the axle.

7. Remove the cotter pin, nut and washer from the radius arm rear attachment.

8. Remove the bushing from the radius arm and remove the radius arm from the vehicle.

9. Remove the inner bushing from the radius arm.

10. Position the radius arm to the axle and install the bolt and nut finger-tight.

11. Install the inner bushing on the radius arm and position the arm to the frame bracket.

12. Install the bushing, washer, and attaching nut. Tighten the nut to 120 ft. lbs. (162 Nm) and install the cotter pin.

13. Tighten the radius arm-to-axle bolt to 269-329 ft. lbs. (366-447 Nm).

14. Install the spring seat and insulator on the radius arm so the hole in the seat fits over the arm-to-axle nut.

15. Install the spring.

16. Connect the shock absorber. Torque the nut and bolt to 40-60 ft. lbs. (54-82 Nm).

17. Install the wheels.

4-Wheel Drive Models

1. Raise the vehicle and position safety stands under the frame side rails.

2. Remove the shock absorber lower attaching bolt and nut and pull the shock absorber free of the radius arm.

3. Remove the lower spring retaining bolt from the inside of the spring coil.

4. Loosen the axle pivot bolt.

5. Remove the nut attaching the radius arm to the frame bracket and remove the radius arm rear insulator. Lower the axle and allow the axle to move forward.

NOTE: The axle must be supported on a floor jack throughout this procedure, and must not be permitted to hang from the brake hose. If the length of the brake hose does not provide sufficient clearance it may be necessary to remove and support the brake caliper.

6. Remove the spring as described above.

7. Remove the bolt and stud attaching the radius arm and bracket to the axle.

8. Move the axle forward and remove the radius arm from the axle. Then, pull the radius arm from the frame bracket.

9. Install the components in the reverse order of removal. Install new bolts and stud type bolts which attach the radius arm and bracket to the axle. Torque the bracket-to-axle bolts to 25 ft. lbs. (34 Nm). Torque the lower radius arm-to-axle bolt to 330 ft. lbs. (449 Nm). Tighten the upper stud-type radius arm-to-axle bolt to 250 ft. lbs. (340 Nm). Torque the radius arm rear attaching nut to 120 ft. lbs. (163 Nm). Torque the lower spring retainer nut to 100 ft. lbs. (136 Nm). Torque the upper spring retainer bolts to 15 ft. lbs. (20 Nm). Torque the axle pivot bolt to 150 ft. lbs. (204 Nm). Torque the lower shock absorber bolt to 60 ft. lbs. (82 Nm).

Twin I-Beam Axles

REMOVAL AND INSTALLATION

NOTE: A torque wrench with a capacity of at least 350 ft. lbs. (476 Nm) is necessary, along with other special tools, for this procedure.

1. Raise and support the front end on jackstands.

2. Remove the spindles.

3. Remove the springs.

4. Remove the stabilizer bar.

5. Remove the lower spring seats from the radius arms.

6. Remove the radius arm-to-axle bolts.

7. Remove the axle-to-frame pivot bolts and remove the axles.

To install:

8. Position the axle on the pivot bracket and loosely install the bolt/nut.

9. Position the other end on the radius arm and install the bolt. Torque the bolt to 269-329 ft. lbs. (366-447 Nm).

10. Install the spring seats.

11. Install the springs.

12. Torque the axle pivot bolts to 120-150 ft. lbs. (162-203 Nm).

13. Install the spindles.

14. Install the stabilizer bar.

Solid I-Beam Axle

REMOVAL AND INSTALLATION

1. Raise and safely support the vehicle. Remove the front wheel spindle, the front spring and the stabilizer bar, if equipped.

2. Remove the spring lower seat from the radius arm and then remove the bolt and nut that attaches the

stabilizer bar bracket, if equipped, and radius arm to the front axle.

3. Remove the axle-to-frame pivot bracket bolt and nut.

To install:

4. Position the axle to the frame pivot bracket and install the bolt and nut finger tight.

5. Position the opposite end of the axle to the radius arm, install the attaching bolt from underneath through the bracket, the radius arm and the axle. Install the nut and tighten to 191-220 ft. lbs. (258-298 Nm).

6. Install the spring lower seat on the radius arm so the hole in the seat indexes over the arm-to-axle bolt. Install the front spring.

7. Install the front wheel spindle and stabilizer bar, if equipped.

8. Lower the vehicle and with the weight on the suspension, tighten the axle-to-frame pivot bracket bolts to 120-150 ft. lbs. (163-203 Nm).

Track Bar

REMOVAL AND INSTALLATION

F-Super Duty Chassis and Cab Models

1. Raise and support the vehicle safely.

2. Remove the wheel cover and the grease cap from the hub. Remove the cotter pin and the retainer. Discard the cotter pin.

3. Loosen the adjusting nut 3 turns.

4. Obtain running clearance between the brake rotor and disc brake pads by rocking the entire wheel and tire assembly in and out several times to push the caliper and brake pads away from the rotor.

NOTE: Do not pry on the caliper piston to obtain clearance.

5. While rotating the wheel, tighten the adjusting nut to 17-25 ft. lbs. (23-34 Nm) to seat the bearings.

6. Back off the adjusting nut 1/2 turn. Retighten the nut to 18-20 inch lbs. (2.0-2.3 Nm).

7. Install the retainer on the adjusting nut so the castellations line up with the hole in the spindle without moving the nut. Install a new cotter pin.

8. Check the front wheel rotation. If the wheel rotates properly, reinstall the grease cap and the wheel cover. If rotation is noisy or rough, remove, inspect and lubricate the bearings and bearing races.

9. Before driving the vehicle, pump the brake pedal several times to restore normal brake travel.

2-Wheel Drive Front Wheel Bearings

ADJUSTMENT

1993-96 Bronco, F-150, F-250 and F-350 Models

1. Raise and support the front end on jackstands.
2. Remove the grease cap and remove excess grease from the end of the spindle.
3. Remove the cotter pin and nut lock shown in the illustration.
4. Loosen the adjusting nut 3 full turns. Obtain a clearance between the brake rotor and brake pads by rocking the wheel in and out several times to push the pads away from the rotor. If that doesn't work, remove the caliper. The rotor must turn freely.
5. Tighten the adjusting nut to 17-25 ft. lbs. (23-34 Nm) while rotating the rotor in opposite directions.
6. Back off the adjusting nut 120-180 degrees ($\frac{1}{2}$ - $\frac{1}{2}$ turn).
7. Install the retainer and cotter pin without additional movement of the locknut.
8. If a dial indicator is available, check the end-play at the hub. End-play should be 0.00024-0.0050 in. (0.006-0.127mm).
9. Install the grease cap.
10. If removed, install the caliper.

1997 F-150 and Expedition Models

1. Raise and support the front end on jackstands.
2. Remove the grease cap and remove excess grease from the end of the spindle.
3. Remove the cotter pin and locknut.
4. Loosen the adjusting nut 3 full turns. Obtain a clearance between the brake rotor and brake pads by rocking the wheel in and out several times to push the pads away from the rotor. If that doesn't work, remove the caliper. The rotor must turn freely.
5. Spin the rotor counterclockwise and tighten the spindle nut to 17-24 ft. lbs. (23-34 Nm).
6. Loosen the spindle nut just shy of $\frac{1}{2}$ revolution (175 degrees).
7. Tighten the spindle nut 17 inch lbs. (1.9 Nm).
8. Install the retainer nut, a new cotter pin and the hub grease cap.

9. Lower the vehicle completely.
10. Make sure that the brakes are operating correctly.

REMOVAL AND INSTALLATION

1993-96 F-150, F-250 and F-350

1. Raise and support the front end on jackstands.
2. Remove the wheel cover. Remove the wheel.
3. Remove the caliper from the disc and wire it to the underbody to prevent damage to the brake hose.
4. Remove the grease cap from the hub. Then, remove the cotter pin, nut lock, adjusting nut and flat washer from the spindle. Remove the outer bearing assembly from the hub.
5. Pull the hub and disc assembly off the wheel spindle.
6. Remove and discard the old grease retainer. Remove the inner bearing cone and roller assembly from the hub.
7. Clean all grease from the inner and outer bearing cups with solvent. Inspect the cups for pits, scratches, or excessive wear. If the cups are damaged, remove them with a drift.
8. Clean the inner and outer cone and roller assemblies with solvent and shake them dry. If the cone and roller assemblies show excessive wear or damage, replace them with the bearing cups as a unit.
9. Clean the spindle and the inside of the hub with solvent to thoroughly remove all old grease.

To install:

10. Covering the spindle with a clean cloth, brush all loose dirt and dust from the brake assembly. Remove the cloth carefully so as to not get dirt on the spindle.
11. If the inner and/or outer bearing cups were removed, install the replacement cups on the hub. Be sure the cups seat properly in the hub.
12. It is imperative that all old grease be removed from the bearings and surrounding surfaces before repacking. The new lithium-based grease is not compatible with the sodium base grease used in the past.
13. Install the hub and disc on the wheel spindle. To prevent damage to the grease retainer and spindle threads, keep the hub centered on the spindle.
14. Install the outer bearing cone and roller assembly and the flat washer on the spindle. Install the adjusting nut.
15. Adjust the wheel bearings by torquing the adjusting nut to 17-25 ft. lbs. (23-34 Nm) with the wheel rotating to seat the bearing. Then back

off the adjusting nut $\frac{1}{2}$ turn. Retighten the adjusting nut to 10-15 inch lbs. (1.12-1.68 Nm). Install the locknut so the castellations are aligned with the cotter pin hole. Install the cotter pin. Bend the ends of the cotter pin around the castellations of the locknut to prevent interference with the radio static collector in the grease cap. Install the grease cap.

WARNING

New bolts must be used when servicing floating caliper units. The upper bolt must be tightened first.

16. Install the wheels.
17. Install the wheel cover.

1997 F-150 and Expedition Models

1. Remove the front disc brake caliper and brake pads.
 2. Remove the 2 front disc brake caliper anchor plate bolts, then lift the anchor plate off of the rotor.
 3. Remove the hub grease cap.
 4. Remove the cotter pin, then remove the retainer nut.
 5. Remove the spindle nut.
 6. Remove the front wheel outer bearing retainer washer.
 7. Remove the outer front wheel bearing.
 8. Slide the front disc brake rotor off of the spindle.
 9. Remove the wheel hub grease seal and inner front wheel bearing.
- To install:**
10. If the inner and/or outer bearing cups were removed, install the replacement cups on the hub. Be sure the cups seat properly in the hub.
 11. Thoroughly clean and inspect the front wheel bearings and the front disc brake hub and rotor.
 12. Lubricate the front wheel bearings with Premium Long-Life Grease Xg-1-C or -K, or equivalent.
 13. Install the front inner wheel bearing, then press in a new inner wheel hub grease seal.
 14. Position the front disc rotor and hub on the spindle.
 15. Install the outer front wheel bearing into the rotor and hub.
 16. Install the outer bearing retainer washer, then install the spindle nut finger-tight.

NOTE: The front disc brake rotor should be rotated while adjusting the front wheel bearing end-play.

17. Tighten the spindle nut to 30 ft. lbs. (40 Nm).
18. Loosen the spindle nut 2 complete revolutions (720 degrees).

19. Spin the rotor counterclockwise and tighten the spindle nut to 17-24 ft. lbs. (23-34 Nm).

20. Loosen the spindle nut just shy of 1/2 revolution (175 degrees).

21. Tighten the spindle nut 17 inch lbs. (2 Nm).

22. Install the retainer nut, a new cotter pin and the hub grease cap.

23. Position the front disc brake caliper anchor plate, then install the mounting bolts to 125-170 ft. lbs. (170-230 Nm).

24. Install the brake pads and brake caliper.

25. Bleed the brake system.

26. Clean the wheel hub mounting surface.

27. Install the front wheels and snug the lug nuts to fully seat the wheel against the hub.

28. Lower the vehicle until some of the vehicle's weight rests on the front tires, then tighten the lug nuts to 83-112 ft. lbs. (113-153 Nm).

29. Lower the vehicle completely.

30. Make sure that the brakes are operating correctly.

4-Wheel Drive Front Wheel Bearings

REMOVAL AND INSTALLATION

Except 1997 F-150 and Expedition Models

WITH MANUAL LOCKING HUBS

1. Raise the vehicle and install safety stands.

2. Refer to Manual Locking Hub Removal and Installation and remove the hub assemblies.

3. On Bronco, F-150 and F-250 LD with the Dana 44 axle: apply inward pressure on the bearing adjusting nut, using a socket made for that purpose, available at most auto parts stores, to disengage the adjusting nut locking splines, while turning it counterclockwise to remove it. On F-250 HD (Dana 50 axle) and F-350, use the hub nut tool to unscrew the outer locking nut. Then, remove the lock ring from the bearing adjusting nut. Use the locknut socket to remove the bearing adjusting nut.

4. Remove the caliper and suspend it out of the way.

5. Slide the hub and disc assembly off of the spindle. The outer wheel bearing will slide out as the hub is removed, so be prepared to catch it.

6. Lay the hub on a clean work surface. Carefully drive the inner

bearing cone and grease seal out of the hub using Tool T69L-1102-A, or equivalent.

7. Inspect the bearing cups for pits or cracks. If necessary, remove them with a drift. If new cups are installed, install new bearings.

To install:

8. Lubricate the bearings with Multi-Purpose Lubricant Ford Specification, ESA-MIC7-B or equivalent. Clean all old grease from the hub. Pack the cones and rollers. If a bearing packer is not available, work as much lubricant as possible between the rollers and the cages.

9. Drive new cups into place with a driver, making sure they are fully seated.

10. Position the inner bearing cone and roller in the inner cup and install the grease retainer.

11. Carefully position the hub and disc assembly on the spindle.

12. Install the outer bearing cone and roller, and the adjusting nut.

13. On Bronco, F-150 and F-250 LD with the Dana 44 axle:

a. Make sure the metal stamping on the adjusting nut faces inboard and the inner diameter key on the nut enters the spindle keyway.

b. Apply inward pressure on the hubnut wrench and tighten the adjusting nut to 70 ft. lbs. (95 Nm) while rotating the hub back and forth to seat the bearings.

c. Apply inward pressure on the wrench and back off the nut about 90 degrees (1/4 turn) then, retighten the nut to 15-20 ft. lbs. (20-27 Nm).

d. Remove the wrench. End-play of the hub/rotor assembly should be 0 (zero) and the torque required to rotate the hub assembly should not exceed 20 inch lbs. (2.24 Nm).

14. Install the outer bearing cone and roller, and the adjusting nut.

15. On the F-250 HD (Dana 50 axle) and F-350:

NOTE: The adjusting nut has a small dowel on one side. This dowel faces outward to engage the locking ring.

a. Using the hub nut socket and a torque wrench, tighten the bearing adjusting nut to 50 ft. lbs. (68 Nm), while rotating the wheel back and forth to seat the bearings.

b. Back off the adjusting nut approximately 90 degrees (1/4 turn).

c. Install the lock ring by turning the nut to the nearest hole and inserting the dowel pin.

WARNING

The dowel pin must seat in a locking hole for proper bearing adjustment and wheel retention!

d. Install the outer lock nut and tighten to 160-205 ft. lbs. (218-279 Nm). Final end-play of the wheel on the spindle should be 0-0.004 in. (0-0.15mm).

16. Assemble the hub parts.

17. Install the caliper.

18. Remove the safety stands and lower the vehicle.

WITH AUTOMATIC LOCKING HUBS

1. Raise the vehicle and install safety stands.

2. Refer to Automatic Locking Hub Removal and Installation and remove the hub assemblies.

3. Using a socket made for that purpose, available at most auto parts stores, use the hub nut tool to unscrew the outer locking nut.

4. Remove the lock ring from the bearing adjusting nut.

5. Use the locknut socket to remove the bearing adjusting nut.

6. Remove the caliper and suspend it out of the way.

7. Slide the hub and disc assembly off of the spindle. The outer wheel bearing will slide out as the hub is removed, so be prepared to catch it.

8. Lay the hub on a clean work surface. Carefully drive the inner bearing cone and grease seal out of the hub using Tool T69L-1102-A, or equivalent.

9. Inspect the bearing cups for pits or cracks. If necessary, remove them with a drift. If new cups are installed, install new bearings.

To install:

10. Lubricate the bearings with Multi-Purpose Lubricant Ford Specification, ESA-MIC7-B or equivalent. Clean all old grease from the hub. Pack the cones and rollers. If a bearing packer is not available, work as much lubricant as possible between the rollers and the cages.

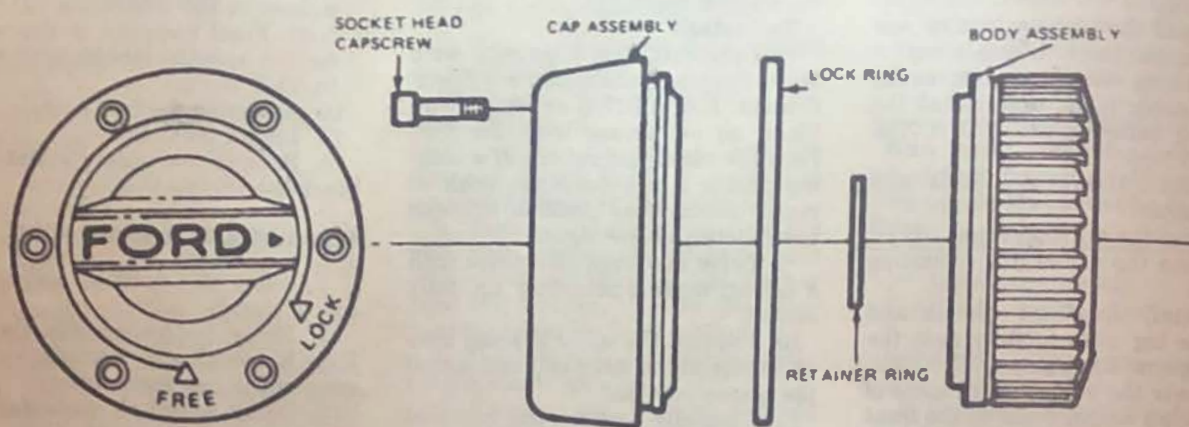
11. Drive new cups into place with a driver, making sure they are fully seated.

12. Position the inner bearing cone and roller in the inner cup and install the grease retainer.

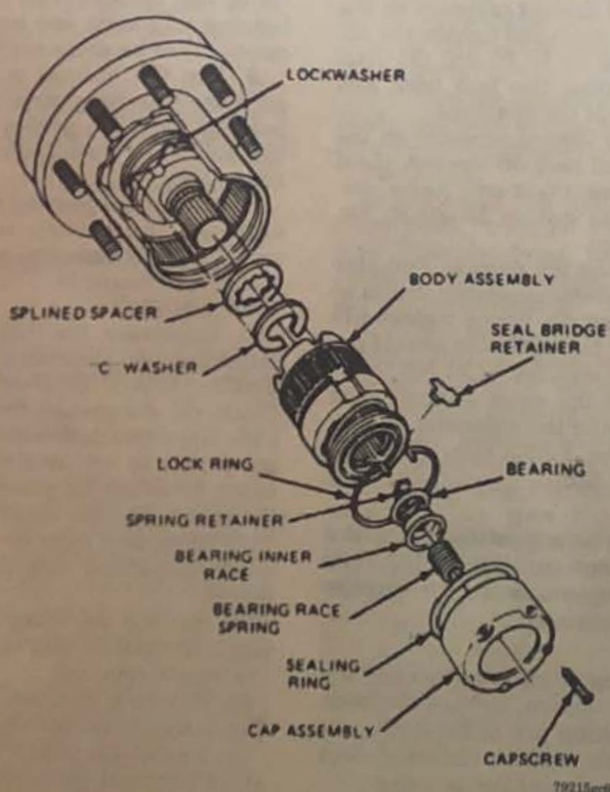
13. Carefully position the hub and disc assembly on the spindle.

14. Install the outer bearing cone and roller, and the adjusting nut.

NOTE: The adjusting nut has a small dowel on one side. This dowel faces outward to engage the locking ring.



Manual locking hub assembly — 1993-96 Bronco, F Series (Pick-Up) and E Series (Van)



Automatic locking hub assembly — 1993-96 Bronco, F Series (Pick-Up) and E Series (Van)

15. Using the hub nut socket torque wrench, tighten the adjusting nut to 50 ft. lbs. (68 Nm) while rotating the wheel back and forth to seat the bearings.

16. Back off the adjusting nut approximately 90 degrees ($\frac{1}{4}$ turn).

17. Install the lock ring by turning the nut to the nearest hole and inserting the dowel pin.

NOTE: The dowel pin seat in a lock ring hole for proper bearing adjustment and retention.

18. Install the outer lock ring and tighten to 160-205 ft. lbs. (217-277 Nm). Final end-play of the wheel spindle should be 0-0.006 in. (0-0.15 mm).

19. Assemble the hub parts.

20. Install the caliper.

21. Remove the safety stand and lower the vehicle.

1997 F-150 and Expedition Models

NOTE: The front wheel bearings are an integral, sealed unit of the front wheel hub; they must be replaced as a single unit.

1. Raise and safely support the front of the vehicle on jackstands.
2. Remove the front wheel.

3. Remove the front disc brake rotor.

4. If equipped with the 4-wheel anti-lock brake system, remove the 3 front disc brake rotor shield bolts, then remove the rotor shield. Also remove the front brake anti-lock sensor.

5. Remove the front axle hub cotter pin, retainer and hub nut.

WARNING

Do not over-extend the CV-joint and boots when removing the hub and bearing assembly.

6. Remove the 3 wheel hub bolts.

NOTE: The CV-joint is a slip fit into the wheel hub and bearing; a puller is not normally required.

7. Push the CV-joint inward, while removing the hub and bearing unit.

8. Remove the hub and bearing seal from the steering knuckle.

To install:

9. Using a seal replacer tool (T96T-1175-A), a threaded drawbar (T77F-1176-A) and a bearing cup replacer (T80T-4000-P), or their equivalents, install a new seal into the steering knuckle.

10. Position the wheel hub on the front wheel halfshaft and into the steering knuckle.

11. Install the 3 hub and bearing unit retaining bolts to 110-148 ft. lbs. (149-201 Nm).

12. If equipped with 4-wheel ABS, install the anti-lock sensor and the disc brake rotor shield.

13. Install the front axle hub nut to 188-254 ft. lbs. (255-345 Nm).

14. Install the nut retainer and a new cotter pin.

15. Install the front disc rotor.

16. Install the wheels, then lower the vehicle to the ground.

To install:

4. Attach the upper end first, then the lower end; don't tighten the nuts yet. If installing new gas shocks, attach the upper end loosely, aim the lower end at its bracket and cut the strap holding the shock compressed. Once extended, these shocks are very difficult to compress by hand.

5. Once the upper and lower ends are attached, tighten the nuts, for all models, as follows:

- 1993-96 Lower nut (except F-Super Duty stripped chassis and motor home chassis) — 52-74 ft. lbs. (71-101 Nm)

- 1993-96 Upper nut (except F-Super Duty stripped chassis and motor home chassis) — 40-60 ft. lbs. (54-81 Nm)

- 1997 Lower nut (F-150 and Expedition models) — 44-60 ft. lbs. (60-81 Nm)

- 1997 Upper nut (F-150 and Expedition models) — 22-29 ft. lbs. (30-40 Nm)

- Upper and lower nuts (F-Super Duty stripped chassis and motor home chassis) — 220-300 ft. lbs. (299-408 Nm)

Leaf Springs

REMOVAL AND INSTALLATION

Except 1997 F-150 and Expedition Models

1. Raise the vehicle by the frame until the weight is off the rear spring with the tires still on the floor.

2. Remove the nuts from the spring U-bolts and drive the U-bolts from the U-bolt plate. Remove the auxiliary spring and spacer, if equipped.

3. Remove the spring-to-bracket nut and bolt at the front of the spring.

4. Remove the upper and lower shackle nuts and bolts at the rear of the spring and remove the spring and shackle assembly from the rear shackle bracket.

5. Remove the bushings in the spring or shackle, if they are worn or damaged, and install new ones.

NOTE: When installing the components, snug down the fasteners. Don't apply final torque to the fasteners until the vehicle is back on the ground.

6. Position the spring in the shackle and install the upper shackle-to-spring nut and bolt with the bolt head facing outward.

7. Position the front end of the spring in the bracket and install the nut and bolt.

8. Position the shackle in the rear bracket and install the nut and bolt.

9. Position the spring on top of the axle with the spring center bolts centered in the hole provided in the seat. Install the auxiliary spring and spacer, if equipped.

10. Install the spring U-bolts, plate and nuts.

11. Lower the vehicle to the floor and tighten the attaching hardware as follows:

U-bolt nuts:

- Bronco, F-150 and F-250 under 8,500 lb. GVW — 75-115 ft. lbs. (102-156 Nm)

- F-250 HD and F-350 — 150-210 ft. lbs. (203-286 Nm)

- F-Super Duty chassis/cab — 200-270 ft. lbs. (272-367 Nm)

- F-Super Duty stripped chassis and motor home chassis — 220-300 ft. lbs. (299-408 Nm)

Spring-to-front spring hanger fasteners:

- F-150 2WD — 75-115 ft. lbs. (102-156 Nm)

- F-250 2WD, F-350 2WD and Bronco — 150-210 ft. lbs. (203-286 Nm)

- F-150, 250, 350 4WD — 150-175 ft. lbs. (203-238 Nm)

- F-Super Duty — 255-345 ft. lbs. (347-469 Nm)

Spring-to-rear spring hanger fasteners:

- All except F-250 and F-350 2WD Chassis Cab — 75-115 ft. lbs. (102-156 Nm)

- F-250 and F-350 2WD Chassis Cab; F-Super Duty — 150-210 ft. lbs. (203-286 Nm)

1997 F-150 and Expedition Models

1. Raise and safely support the rear of the vehicle on jackstands. Make sure to block the front wheels for safety.

2. Remove the rear wheels.

3. Support the rear axle under the differential case with an hydraulic floor jack.

4. Remove the 4 leaf spring U-bolt nuts, then remove the U-bolts.

NOTE: It is easier to remove the spring from one side of the vehicle at a time, since the spring which is still attached will help position the axle during installation.

5. Remove the leaf spring plate and spacer (4x4 models), then slowly lower the rear axle.

REAR SUSPENSION

Shock Absorber

REMOVAL AND INSTALLATION

1. Raise and support the rear end on jackstands.

2. Remove the self-locking nut, steel washer and bolt from the lower end of the shock absorber. Swing the lower end away from the bracket.

3. Remove the upper mounting nut and washer.

5 FORD MOTOR CO. BRONCO/E-SERIES VAN/EXPEDITION

6. Remove the leaf spring-to-front frame bracket bolt and nut.

7. Remove the spring-to-shackle upper bolt and nut.

8. Remove the leaf spring from under the vehicle.

To install:

9. Position the rear leaf spring under the truck.

10. Install the spring-to-shackle upper bolt and nut to 72-97 ft. lbs. (98-132 Nm).

11. Install the spring-to-front frame bracket bolt and nut to 72-97 ft. lbs. (98-132 Nm).

12. Raise the rear axle with the floor jack until it rests against the leaf spring, then install the spacer (4x4 models) and the plate.

13. Install the U-bolts and nuts to 72-97 ft. lbs. (98-132 Nm).

14. Repeat the procedure for the other leaf spring, if necessary.

15. Install the rear wheels and lower the vehicle to the ground.

ADJUSTMENTS

Except 1997 F-150 and Expedition Models

Side-to-side lean can be adjusted by about $\frac{1}{8}$ in. (10mm) by installing a shim between the spring and axle on the low side. A vehicle that is low in the rear on both sides can be similarly raised by the insertion of 1 shim on each side.

If the side-to-side lean is greater than $\frac{1}{2}$ in., try switch the springs from one side to the other.

Stabilizer Bar

REMOVAL AND INSTALLATION

1. Remove the nuts from the lower ends of the stabilizer bar link.

2. Remove the outer washers and insulators.

3. Disconnect the bar from the links.

4. Remove the inner insulators and washers.

5. Unbolt the link from the frame.

6. Remove the U-bolts, brackets and retainers.

7. Installation is the reverse of removal. Replace all worn or cracked rubber parts. Coat all new rubber parts with silicone grease. Assemble all parts loosely and make sure the bar assembly is centered before tight-

ening the fasteners. Observe the following torque figures:

- Stabilizer bar-to-axle nut, except F-Super Duty — 30-42 ft. lbs. (41-57 Nm)

- Stabilizer bar-to-axle bolt, F-Super Duty chassis/cab — 27-37 ft. lbs. (37-50 Nm)

- Stabilizer bar-to-axle bolt, F-Super Duty stripped chassis and motor home chassis — 30-47 ft. lbs. (41-64 Nm)

- Link bracket-to-frame nut, 4WD — 30-42 ft. lbs. (41-57 Nm)

- Link-to-bracket nut, 4WD — 60 ft. lbs. (81 Nm)

- Link-to-frame nut, 2WD — 60 ft. lbs. (81 Nm)

- Stabilizer bar-to-link — 15-25 ft. lbs. (20-34 Nm)

Wheel Bearings

REMOVAL AND INSTALLATION

NOTE: The specific axle designation is found on the rear axle identification tag, located on the differential cover.

Ford 7.5 and 8.8 Inch Rear Axles

1. Raise and safely support the vehicle.

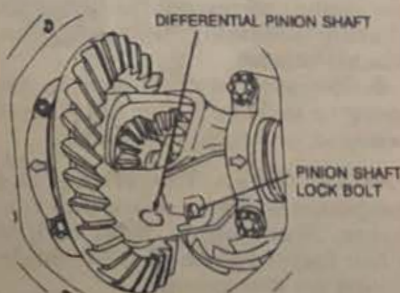
2. Remove the rear wheel and tire assemblies and the brake drums.

3. Clean all dirt from the carrier cover area. Position a drain pan under the carrier, remove the cover and drain the rear axle.

NOTE: Whenever a plastic rear axle cover is removed, it must be replaced with a new cover and bolts. Steel rear axle covers may be reused.

4. For all 8.8 in. axles and all 7.5 in. axles except 3.73:1 and 4.10:1 ratio axles, proceed as follows:

a. Remove the differential pinion shaft lock bolt and pinion shaft.



Differential pinion shaft and pinion shaft lockbolt location — Ford 7.5 and 8.8 inch rear differentials

b. Push the flanged end of the axle shafts toward the center of the vehicle and remove the C-lock from the button end of the axle shaft.

c. Remove the axle shaft from the housing.

d. Reinstall the pinion shaft and lock bolt to ensure the pinion gears remain in place.

5. On 7.5 in. axles equipped with 3.73:1 and 4.10:1 axle ratios, proceed as follows:

a. Remove the pinion shaft lock bolt.

b. Push out the pinion shaft until the step on the shaft contacts the ring gear.

c. Remove the C-lock from the axle shaft.

d. Remove the axle shaft from the housing.

e. Reinstall the pinion shaft and lock bolt to ensure the pinion gears remain in place.

6. Using bearing remover T83T-1225-A, or equivalent, and a suitable slide hammer, remove the axle bearing and seal as a unit.

To install:

7. Lubricate a new bearing with rear axle lubricant and install in the housing bore using a suitable driver.

8. Apply grease to the lips of a new seal and install, using a seal installer.

9. Remove the pinion shaft lock bolt and pinion shaft. On 7.5 in. axles equipped with 3.73:1 and 4.10:1 axle ratios, push out the pinion shaft until the step contacts the ring gear.

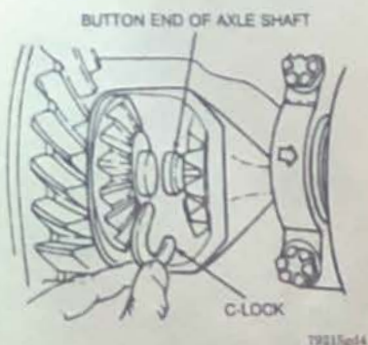
10. Slide the axle shaft into the axle housing, being careful not to damage the seal or axle bearing. Start the splines into the side gear and push firmly until the button end of the axle shaft can be seen in the differential case.

11. Install the C-lock on the button end of the axle shaft, then pull the shaft outboard until the shaft splines engage and the C-lock seats in the counterbore of the differential side gear.

NOTE: On 8.8 in. axles, a rubber O-ring is used to hold the C-lock in position on the axle shaft. Make sure the O-ring is in the groove at the button end of the axle shaft before installing the C-lock.

12. Slide the pinion shaft through the case and pinion gears, aligning the hole in the shaft with the lock bolt hole. Install the lock bolt and tighten to 15-30 ft. lbs. (20-40 Nm).

13. Clean all old sealer from the carrier and cover surfaces. Apply a bead of RTV sealer $\frac{1}{8}$ - $\frac{1}{4}$ in. wide. The



Axle shaft C-lock removal and installation — Ford 7.5 and 8.9 inch rear differentials

bead should be continuous and should not pass through or outside the holes.

14. Install the cover and tighten the bolts to 15–20 ft. lbs. (21–27 Nm) if equipped with a plastic cover or 25–35 ft. lbs. (34–37 Nm) if equipped with a steel cover. Fill the carrier with the proper type and quantity of fluid.

15. Install the brake drums and the wheel and tire assemblies. Lower the vehicle.

Dana 30 and 35-1A Rear Axles

1. Raise and safely support the vehicle.

2. Remove the rear wheel and tire assemblies and the brake drums.

3. Working through the hole provided in the axle shaft flange, remove the nuts that secure the wheel bearing retainer plate. These are torque prevailing nuts and must not be reused.

4. Pull the axle shaft assembly out of the axle housing using puller adapter tool T66L-4234-A or equivalent, and a suitable slide hammer.

5. Remove the axle shaft carefully so as not to damage the outer seal. Remove the bearing race from the housing using a slide hammer type puller and bearing race puller tool T77F-1102-AA or equivalent. Remove the brake backing plate and wire it to the chassis.

6. Mount the axle shaft in a suitable fixture. Drill a $\frac{1}{4}$ – $\frac{1}{2}$ in. hole in the outside diameter of the inner retainer ring to a depth approximately $\frac{1}{8}$ in. in the thickness of the retainer ring. Do not drill all the way through the retainer ring as this will damage the axle shaft.

7. After drilling the retainer ring, use a chisel positioned across the drilled hole and strike sharply to split the retainer ring.

8. Put the outer bearing race on the axle shaft assembly and place the axle shaft in tool T75L-1165-A, B, C or equivalent. Assemble the 2 halves of the remover collet and tighten the bolts.

9. Press the bearing and seal assembly off of the shaft. Never use heat as this would damage the axle shaft. Inspect the retainer plate for possible distortion and replace if damaged.

To install:

10. Install the outer retainer plate, if removed. Make sure it is not installed backwards.

11. Place a new lubricated seal and bearing on the axle shaft, making sure the race rib ring is facing the axle flange.

12. Press the tapered-bearing and seal assembly onto the axle shaft using tools T75L-1165-B, service plate and adapter tool T75L-1165-DA or equivalents. Apply enough pressure to seat the bearing against the axle shaft shoulder. Do not attempt to press on the bearing retainer at the same time.

13. Position a new bearing retainer on the shaft, then press it into position firmly against the bearing.

14. Apply lubricant to the outer diameter of the race and seal. Install the brake backing plate and attaching bolts.

15. Before sliding the shaft assembly into the axle housing, make sure the outer seal is fully mounted on the bearing.

16. Carefully slide the axle shaft into the housing, start the axle splines into the side gear and push the shaft in until the bearing bottoms in the housing.

17. Install the bearing retainer plate and nuts. Tighten the nuts to 25–35 ft. lbs. (34–47 Nm).

18. Install the brake drum and the wheel and tire assembly.

19. Add lubricant through the filler hole until the level reaches $\frac{1}{4}$ – $\frac{1}{2}$ in. (3–16mm) below the bottom of the filler hole. The axle must be in the running position and the vehicle level.

20. Lower the vehicle.

Full Floating Rear Axle

F-250 HD and F-350

The wheel bearings on the Ford 10 $\frac{1}{2}$ in. full floating rear axle are packed with wheel bearing grease. Axle lubricant can also flow into the wheel hubs and bearings, however, wheel bearing grease is the primary lubricant. The wheel bearing grease provides lubrication until the axle lubri-

cant reaches the bearings during normal operation.

The wheel bearings on the full floating rear axle are packed with wheel bearing grease. Axle lubricant can also flow into the wheel hubs and bearings, however, wheel bearing grease is the primary lubricant. The wheel bearing grease provides lubrication until the axle lubricant reaches the bearings during normal operation.

1. Set the parking brake and loosen the axle shaft bolts.

2. Raise the rear wheels off the floor and place jackstands under the rear axle housing so the axle is parallel with the floor.

3. Remove the wheels.

4. Remove the brake drums.

5. Remove the axle shaft bolts.

6. Remove the axle shaft and discard the gaskets.

7. With the axle shaft removed, remove the gasket from the axle shaft flange studs.

8. Install Hub Wrench T85T-4252-AH, or equivalent, so the drive tangs on the tool engage the slots in the hub nut.

NOTE: The hub nuts are right hand thread on the right hub and left hand thread on the left hub. The hub nuts should be stamped RH and LH. Never use power or impact tools on these nuts! The nuts will ratchet during removal.

9. Remove the hub nut.

10. Install step plate adapter tool D80L-630-7 or equivalent, in the hub.

11. Install puller D80L-1002-L or equivalent, and loosen the hub to the point of removal. Remove the puller and step plate.

12. Remove the hub, taking care to catch the outer bearing as the hub comes off.

13. Install the hub in a soft-jawed vise and pry out the hub seal.

14. Lift out the inner bearing.

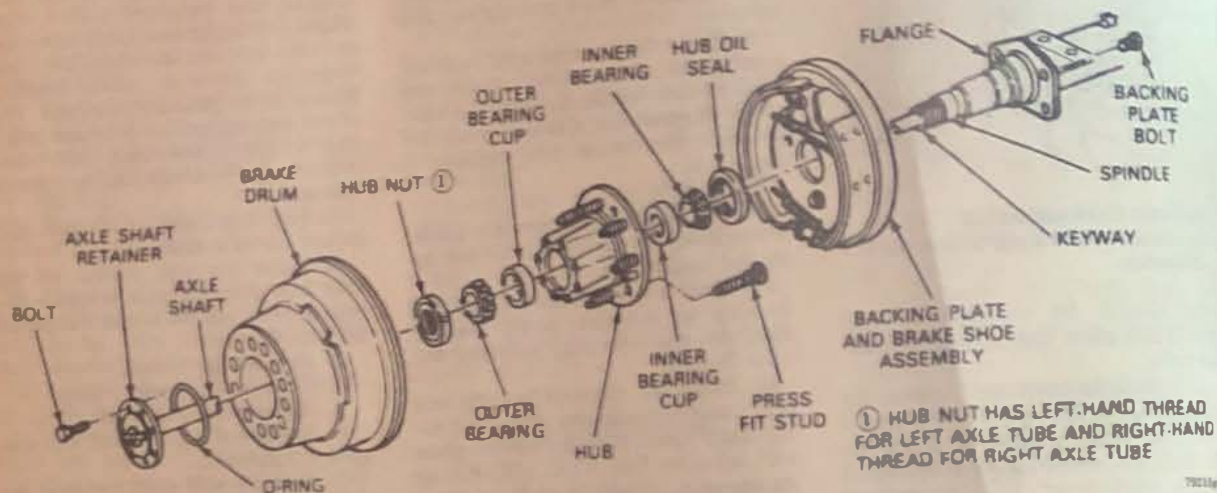
15. Drive out the inner and outer bearing races with a drift.

16. Wash all the old grease or axle lubricant out of the wheel hub, using a suitable solvent.

17. Wash the bearing races and rollers and inspect them for pitting, galling, and uneven wear patterns. Inspect the roller for end wear. Replace any bearing and race that appears in any way damaged. Always replace the bearings and races as a set.

To install:

18. Coat the race bores with a light coat of clean, waterproof wheel bearing grease and drive the races



Full-floating axle shaft, bearing and hub assembly — F-250 Heavy Duty and F-350 models

squ岸ely into the bores until they are fully seated.

19. Pack each bearing cone and roller with a bearing packer.

20. Place the inner bearing cone and roller assembly in the wheel hub.

NOTE: When installing the new seal, the words **OIL SIDE** must go inwards towards the bearing!

21. Place the seal squarely in the hub and drive it into place. The best tool for the job is a seal driver such as T85T-1175-AH, which will stop when the seal is at the proper depth.

NOTE: If the seal is misaligned or damaged during installation, a new seal must be installed.

22. Clean the spindle thoroughly. If the spindle is excessively pitted, damaged or has a predominately bluish tint (from overheating), it must be replaced.

23. Coat the spindle with 80W/90 oil.

24. Pack the hub with clean, waterproof wheel bearing grease.

25. Pack the outer bearing with clean, waterproof wheel bearing grease.

26. Place the outer bearing in the hub and install the hub and bearing together on the spindle.

27. Install the hub nut on the spindle. Make sure the nut tab is located in the keyway prior to thread engagement. Turn the hub nut onto the threads as far as possible by hand, noting the thread direction.

28. Install the hub wrench tool and tighten the nut to 55-65 ft. lbs. (75-88 Nm). Rotate the hub occasionally during nut tightening.

29. Ratchet the nut back 5 teeth; make sure you hear 5 clicks!

30. Inspect the axle shaft O-ring seal and replace it.

31. Install the axle shaft.

32. Coat the axle shaft bolt threads with waterproof seal and install them by hand until they seat; do not tighten them with a wrench at this time!

33. Check the diameter across the center of the brake shoes. Check the diameter of the brake drum. Adjust the brake shoes so their diameter is 0.030 in. (0.76mm) less than the drum diameter.

34. Install the brake drum

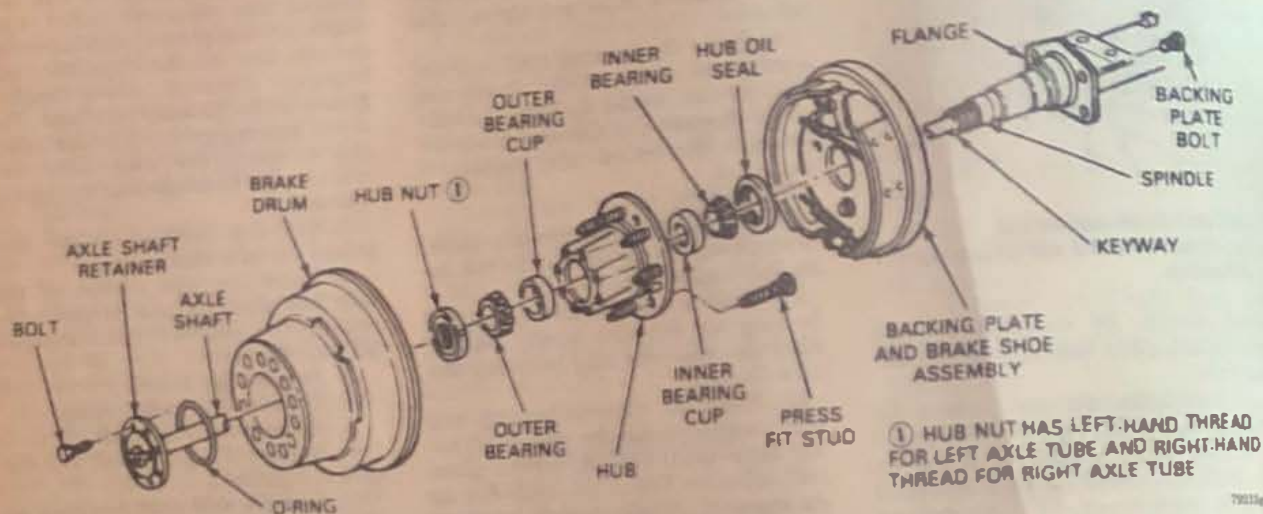
35. Install the wheel.

36. Loosen the differential filler plug. If lubricant starts to run out retighten the plug. If not, remove the plug and fill the housing with 80W/90 gear oil.

37. Lower the vehicle to the floor.

38. Tighten the wheel lugs to 140 ft. lbs. (190 Nm).

39. Now tighten the axle shaft bolts. Torque them to 60-80 ft. lbs. (81-109 Nm).



Full-floating axle shaft, bearing and hub assembly — F-250 Heavy Duty and F-350 models

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MERCURY and NISSAN

MERCURY-Villager NISSAN-Quest

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